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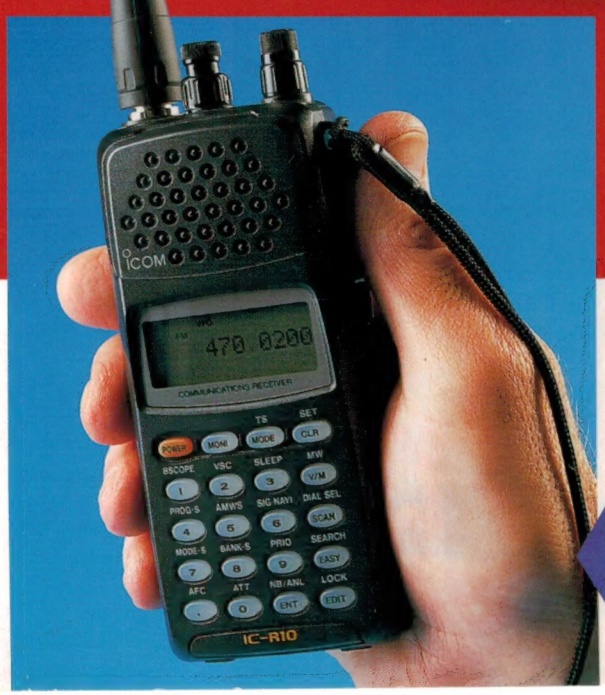

THE CELLPHONE RISK REPORT THEY TRIED TO 'BURY'...

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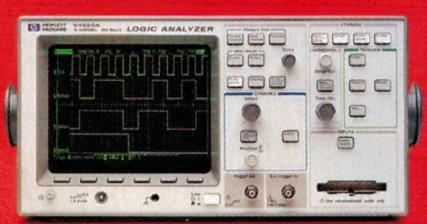

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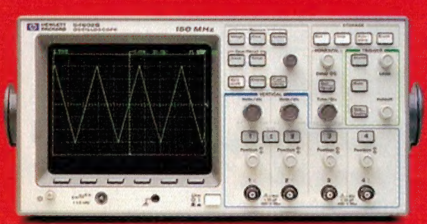

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HEWLETT PACKARD

Electronics

AUSTRALIA with Professional Electronics & ETI

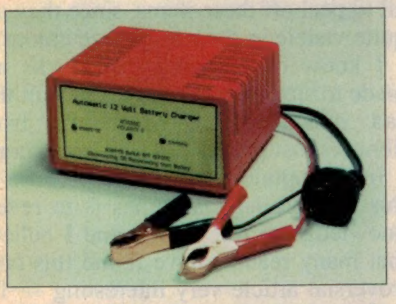
Volume 59, No.7
July 1997

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Behind AMD's K6 chip

How do you really compete with an industry leader as large as Intel? AMD's strategy has been to acquire the key technology needed, plus the key people to develop it. Vinod Dham is one of those key people — he developed the 386, 486 and early Pentium processors at Intel. See our story starting on page 32...

Regulation for chargers



Low cost 12V battery chargers can do the job, but you have to be careful to turn them off before they overcharge your battery. Peter Harle's new add-on regulator circuit converts a cheap 'no frills' charger into a fully regulated automatic type. His article describing it starts on page 56.

On the cover

Although quite compact, the Bose Wave Radio incorporates some of the innovative technology used in Bose's much more expensive hifi systems. Louis Challis has been putting it through its paces — his review starts on page 10. (Photo by Kevin Ling) Icom's tiny IC-R10 was captured by Phil Aynsley (see review page 16).

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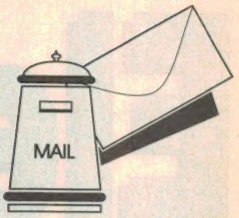
LETTERS TO THE EDITOR



ESR meter kits

I've been following the Letters To The Editor regarding a company which supplies 'SHORT FORM Low Cost Micro-Based ESR & Low OHMS Meter' kits, minus the essential microcontroller IC itself. As the designer of this project, I feel that a statement from me on the subject is long overdue.

When I wrote the article I indicated that the programmed micros would be supplied with all kits, because this was what I (naively in hindsight) *expected* would happen. The major kit suppliers have been happy to follow this arrangement. The possibility that one supplier would make a liar of me by selling kits minus the micro, and then not advertising this fact, simply never occurred to me. The first I knew about this company including a piece of paper in the kit, directing the constructor to *me* for the micro, was when I started receiving orders, the wording of which varied from abrupt to (understandably) furious.

On two occasions I was speaking to a senior person in the company, and I indicated that this arrangement was making them a lot of angry (ex-) customers. On each occasion I offered to program the micros for them, as I was doing for the big kit suppliers, but he seemed barely interested and my offer was never taken up.

Because of the number of people who clearly assumed that I am a greedy individual 'in cahoots' with this company to 'make a fast buck', I wrote an explanatory note making it very clear that not only is this 'unadvertised missing microcontroller' procedure NOT my idea, I totally *oppose* it. A copy of that note has gone out with every programmed micro for this kit, for many months.

Some readers might also recall the note I put on the EA BBS, warning potential builders of this kit that it contains no microcontroller — along with a list of wrong-value components known to be often included in the same kit.

To sum up, I completely agree with E. Gordon Wormald's letter in the February 1997 issue, and with Timothy Newsom's comments on it in the May 1997 edition. If someone was to take this company to Consumer Affairs in relation to this matter, I would be the first to applaud them!

Bob Parker,
Carlton, NSW (Via the BBS)

Disappointed too

I was even more disappointed by the letter from Mr Groenewegen (March 1997), commenting on the article about theft protection devices, than he was with Tom Moffat's original article (September 1996).

I can fully understand and respect his feelings about making knowledge stored in the books available to everyone, but I think he is not aware of reality. Devices that the above-mentioned article discussed are not at all invisible, and any moron with a grain of commonsense can remove them from the product that is being protected, without any need for the information contained in the article. For example my local library uses magnetic strips attached to the back of CDs, and a VHF receiver-transmitter for its books and periodicals. It is no effort at all to peel off these items, since they are quite visible in their bright red colour.

I know of a saying that 'locks are made to stop honest people', and all this sad disappearance of books from libraries just proves it's true once more.

In my opinion, the whole purpose of this and similar magazines is to reveal knowledge to the public, and I believe that many readers have found this controversial article very interesting — for purely academic, and not criminal purposes. After all, if a thief has no idea how to open a bank vault, he can always blow it up with TNT.

Mike Vujica,
Liverpool, NSW.

Beware fuel cutoff!

I currently own a 1991 VW Double Cab Transporter, and on a recent trip the vehicle developed an intermittent misfire. The only clue was a very sick sounding fuel pump.

The local dealership diagnosed a dodgy fuel pump. To me it just didn't seem to make sense that the fault would be intermittent.

A new pump was fitted and of course the problem still occurred. Back to the

mechanic. A new ECU was prescribed. Now a couple of hundred for a new pump is OK, but a couple of thousand for a new ECU was not. It was time to have a look myself.

In the fuel tank of a Kombi there is a large fuel filter/cutoff; from this a plastic moulded pipe runs to the outlet in the tank. The filter is self cleaning and maintenance free, thanks to the return of unused fuel from the motor.

The electric fuel pump is a roller-cell pump driven by a permanent-magnet electric motor, and as stated in the Bosch *Automotive Electric/Electronic Systems Handbook*, the fuel flows directly around the electric motor. There is no danger of explosion, however, because there is never an ignitable mixture in the pump housing — hence the fuel cut-off.

In this case the moulded plastic pipe had dislodged. The noise from the pump was caused by an air/fuel mixture being introduced when the tank was running low on fuel. A good example of how a two-cent component could have cost thousands to fix!

Brett Delaney,
Highfields, NSW

Time warp?

January *EA* seems to have come out of a time warp with your article on the Iomega Zip 100 drive — for an item that was available some 18 months ago complete with a special offer from Dick Smith in early 1996. One can only wonder just what is going on.

Having sold the item to local customers in March 1996 and then had hard words over the unfair pricing policy adopted by the distributor, it leaves a sour taste in the mouths of small dealers like myself.

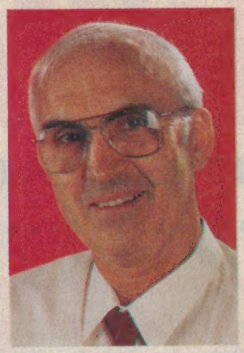
Current dealer pricing from distributors is $341.61 per drive with one disk; a two-disk pack is $75.27, all plus freight which if you allow for a markup of 10%, comes to the all-up figure of approximately $475.00. The best price we dealers can buy disks for is $231.60 per 10 disks plus freight.

Do you wonder that small dealers are telling these kind of distributors just what to do with their product?

R.J. (Jim) McCloy,
Muswellbrook, NSW. ❖

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We welcome contributions to this column, but reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



The digital revolution continues...

Sometime back in the early 1970s, it became clear to me that most of electronics was 'going digital'. I remember I wrote a leader around then, suggesting that before long we'd 'even have washing machines and toasters with microprocessor-based controllers'. At the time, it seemed a fairly way-out and forward looking idea...

A few weeks ago, though, after a hectic visit to Silicon Valley for meetings and presentations from 10 of the leading US semiconductor firms, it struck me that when I wrote that original leader I really had *no idea* of just how true it would turn out to be. Although we've had CDs and things like microcontroller-based washing machines for some time now, the digital revolution is by no means complete. In fact it's probably only just begun.

There's incredible effort going into the development of powerful new DSP (digital signal processing) chips, for example, for audio processing applications like digital telephony, surround sound, karaoke systems, solid state recorders and even fully digital radio receivers with no 'tuned circuits' at all — the signal selection and demodulation is all done by DSP, after digitising the RF input signals!

A lot of development effort is also going into flash memory and 'smart card' technology, along with secure digital encryption systems capable of supporting (you guessed it) electronic financial transactions. The era of digital 'virtual cash' is clearly almost here, where you'll have a baby ATM in your home or office, and be able to refill your electronic wallet from your bank account at any time of the day or night (even from a hotel room overseas).

In the PC area, designers are now clearly working towards processors running at speeds of 1GHz and above, with up to 1GB of RAM and able to process video and audio with greater facility than today's high-end PCs can handle still images. This will almost certainly happen in the next five years. (At a demonstration by Sunnyvale firm nVidia to display its new Riva128 3D graphics accelerator chip, we saw real-time full screen 3D graphics of virtually video quality, generated on a standard mid-range Pentium-based PC.)

One aspect of all this that I really didn't anticipate was the extent to which digital technology has such a built-in multiplier effect. The current generation of fancy digital chips have all been developed faster than ever before, thanks to much more powerful EDA (electronic designer assistance) software tools running on ever more powerful (and cheaper) PCs and workstations. And the *next* generation of chips will be developed using even *more* powerful tools again. So it's definitely not slowing down, folks — it's still accelerating.

Here's a question: how long do you think it will be before we see the first fully digital hifi power amplifier — where analog signals don't even appear before the output of the stages driving the speakers? My guess is within five years. It'll probably be so efficient it won't need any heatsinks, either.

Jim Rowe

PS: Don't miss next month's issue of *EA* — it's our 75th Anniversary issue, and will contain a special supplement to commemorate this milestone...

WHAT'S NEW

IN THE EVER-CHANGING WORLD OF ELECTRONICS

'Flagship' AC-3 home theatre receiver from Onkyo

Onkyo's new Integra TX-DS838 Home Theatre Receiver is an advanced design featuring built-in Dolby Digital (AC-3) surround decoding, dual DSP processors and 12 surround modes.

The set features discrete output circuitry and is claimed to provide sound with breath-taking realism, delivering 100W RMS per channel in stereo mode, or 90W RMS to the front left, centre and right channels and 50W RMS to each of the rear channels in surround mode. The non-NFB (negative feedback) power amplifiers feature dual inverted Darlington circuitry to reduce distortion. Heavy-duty power supplies feature an automatic cooling fan which switches on under heavy loads to prevent overheating.

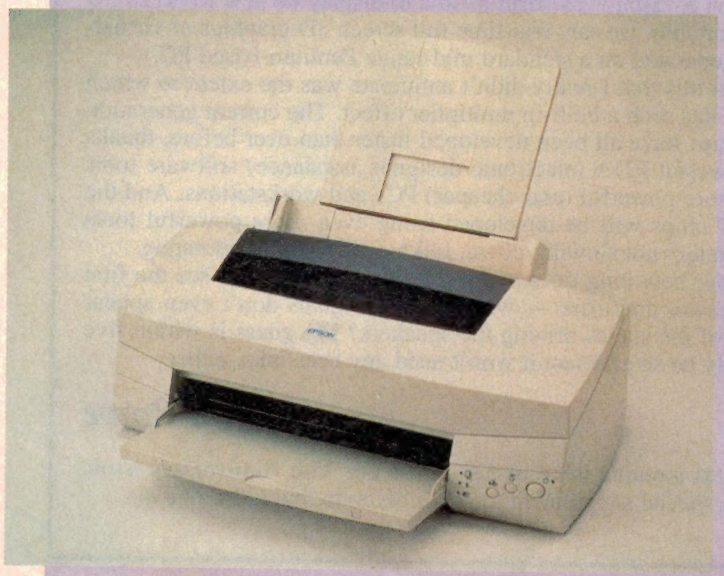
The TX-DS838 is equipped with dual 24-bit Motorola 56009 and 56004 DSP chips working in unison to provide dramatically improved DSP processing capability and highly detailed surround sound performance.

The TX-DS838 features comprehensive video signal routing and switching, with four video and eight audio inputs. A front-panel input (Video 4) is provided for easy connection and playback from a camcorder. A new user-friendly three page on-screen display offers easy-to-follow adjustment of all operating parameters. Intelligent Power Management automatically activates the entire AV system when the connected television is switched on.

The Onkyo TX-DS838 measures 435 x 175 x 428mm, weighs 15kg, is finished in black brushed or burnished gold aluminium, and has an RRP of $2999.

For further information circle 145 on the reader service card or contact Onkyo distributor Amber Technology at Unit B, 5 Skyline Place, Frenchs Forest 2086; phone (02) 9975 1211 or fax (02) 9975 1368.

New Epson inkjets offer photo quality



Epson's new Stylus Photo high-quality colour inkjet printer uses a six-colour printing system, and is claimed to set a new standard for 'photo reproduction' quality.

The Stylus Photo is a dedicated photo-reproduction A4 inkjet printer intended for the professional photography market, graphics professionals, photography enthusiasts and in-house marketing departments.

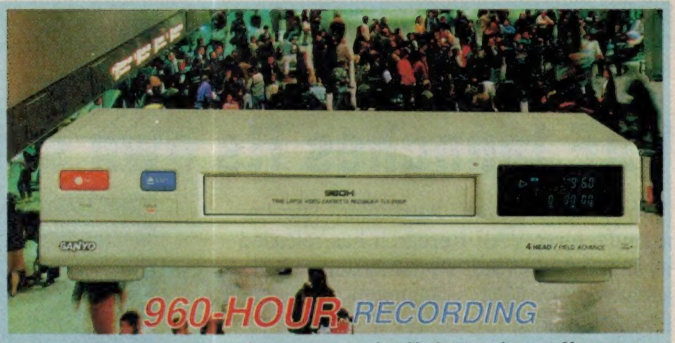
Using Epson's Quick-Dry ink technology, the printer has added two light colour inks (light cyan and light magenta) to the traditional CMYK (cyan, magenta, yellow, black) combination. It is also claimed to take the PerfectPicture Imaging System technology a step further, by means of technological advancements to the print head, ink and printer driver. The new Epson Micro Piezo printhead is claimed to provide sharper output and produce less misting than other inkjet technologies — without compromising print speed.

Using its six-colour (CcMmYK) printing system and advanced printer driver, the Stylus Photo prints on a variety of paper from plain to photo quality glossy film and Epson's new Photo paper.

The EPSON Stylus Photo is available now from leading retailers and dealers, with an RRP of $999. Epson Photo Paper is available for $18 ERP including tax.

For further information circle 148 on the reader service card or contact Epson Australia on (02) 9903 9000, or at its Web site at **http://www.epson.com.au**.

Time-lapse video recorder from Sanyo



Sanyo Australia has released a new Time Lapse VCR, with the ability to record for up to 960 hours (40 days) continuously on a standard E-180 VHS tape. The unit offers a choice of 12 tape speeds, including standard three-hour speed for maximum information capture and the popular 72-hour (three days) and 168-hour (seven days) speeds.

In addition to the usual security VCR features, the Sanyo TLS2100P includes Alarm Search and Alarm Scan plus the ability to search for alarms by time and date. These search functions are great time savers when looking for particular events which may have caused alarms.

The TLS2100P allows the video signal to pass through for live monitoring even when the power to the machine is switched off. Audio recording and playback is operational in the three, 12 & 24-hour modes.

Other features include automatic video head cleaning, multiple on-screen menu languages, daylight saving adjustment and reverse playback capability.

For further information circle 146 on the reader service card or contact distributor Javelin Electronics at 1/24 Prince William Drive, Seven Hills 2147; phone (02) 9838 0888 or fax (02) 9838 0988.

New digital still camera from Sony

Sony Electronics, long known as a leader in digital image capture technology, has introduced in the USA its new DKC-ID1, a handheld digital still camera that lets users capture and download high quality images to personal computers. Features of the camera include a built-in 12X zoom lens with 38 - 460mm equivalent range, and a built-in colour LCD viewfinder for effectively TTL shot composition — as well as review of captured images. Since its announcement, the DKC-ID1 has won wide acclaim and was awarded the US Photo Marketing Association's prestigious DIMA award for innovative digital product. Equipped with a 450K-pixel progressive-scan CCD that provides full colour, high resolution images of 768 x 576 pixels and effective shutter speeds from 1/15 to 1/4000 second. The camera itself measures 127 x 145 x 66mm and weighs 3.5kg. It is designed to be handheld and can store up to 140 images on a 10MB PCMCIA card. Standard JPEG compression insures compatibility with a wide range of software. It can also connect directly to a PC via a built-in SCSI interface.

For additional convenience, the camera uses the same rechargeable lithium ion batteries as Sony Handycam camcorders.The camera's built-in flash (guide number 16) provides high quality lighting in a variety of situations. With a sensitivity equivalent to ISO 100, the DKC-ID1 allows the user to select between programmed auto exposure or shutter priority auto exposure. And for the most accurate exposure in tricky lighting situations, it has +/-3EV compensation. Focus and shutter speed are likewise selectable between manual and automatic. For ease of use, an LCD display on the rear of the unit shows the status of the flash, exposure, storage and focus modes and how many images are stored. The user can select one of two storage modes: Fine, which allows approximately 40 images to be stored on a 10MB PCMCIA (ATA Type 2) card, and Normal which allows 140 images to be stored.

The DKC-ID1 comes ready-to-use with a lithium ion battery, 2MB PCMCIA memory card, and a battery charger. In the USA it is currently available at a suggested retail price of US$1795.

Speakers use 'prism' technology

British manufacturer B&W Loudspeakers claims to have found a way to produce higher quality sound from a smaller cabinet, and at an affordable price. The company has called its new development the 'Prism' system, because it uses carefully optimised tapered quasi-pyramid shapes placed inside the speaker cabinet. The shapes are sound absorbent, and the idea is to stop sound from bouncing around inside the cabinet and adversely affecting the output.

Prism technology is used in B&W's new 300 Series of speakers, a range that comprises the floor-standing DM#305 design, the bookshelf size DM#302 and the model CC#3, designed for home cinema centre channel situations.

According to Australian distributor Convoy International, the Prism system gives the B&W 300 Series a quality of reproduction that is elevated several notches, particularly in the area of vocal sounds, where voices are sweet and warm.

B&W has applied for a patent for the Prism system, and is looking at incorporating it in a wide variety of other model speakers in its stable. The B&W model DM#302 has also been voted European Loudspeaker of the Year by the people from Europe's leading home entertainment magazines.

More information is available by circling 144 on the reader service card, or from Convoy International on Freecall 1800 251 995.

VAF launches its own satellites

Innovative South Australian speaker manufacturer VAF Research has released its first Satellite/Subwoofer system which, according to VAF's Managing Director Philip Vafiadis, "...sets a new standard for systems of this type".

The I-76 range is claimed to deliver 'true hifi in miniature' offering high technology materials, advanced design and compact dimensions. Sound quality is of a very high standard with detail, imaging and dynamics superior to those normally found in such systems. "The linearity and absence of compression are spectacular for speakers in this class", says Philip. "They deliver a real hifi sound, without the feeble dynamics and lack of resolution that plague most sat/sub systems".

As with all VAF speakers the I-76's are also available in ready to assemble form for those who want to save even more money.

I-76 satellite features include ultra-rigid composite fibreglass cone drivers which reduce colourations significantly, with 'T' shaped pole pieces; also super high density 'HD3' cabinets with fully mitred construction and a finely textured black finish, giving a solid feel of quality and elegance.

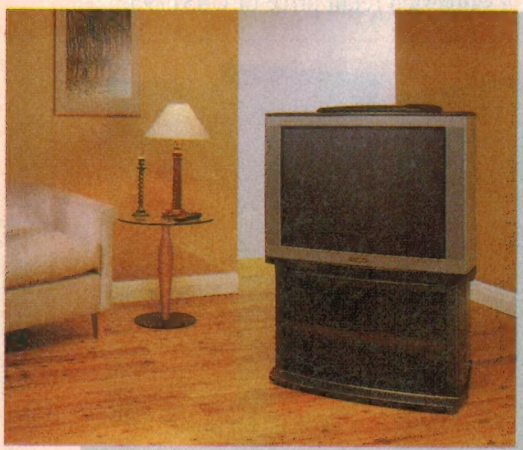
The range includes a new stereo subwoofer featuring two 210mm fibreglass cone drivers in a precise band-pass alignment delivering tight bass to below 30Hz, and high pass filters to permit 100W+ power handling from the system.

Three satellite models are available: a wide range unit featuring the high-tech 100mm driver, a two-way unit which adds a 10mm 24k gold tweeter, and a shielded version for A/V and multimedia use.

While the I- 76's can plug into any system from almost any other manufacturer, VAF has formed a close association with AMC, who offer no frills, high quality products at affordable prices. Through this association VAF now offer a high quality, affordable, entry-level, Dolby Surround Sound package by combining their I-76 Satellite System with AMC's PRO7 Home Entertainment Control Centre and 2445 multi channel power amplifier.

As with all VAF products they are only available directly from the factory. For further information circle 142 on the reader service card or contact VAF Research at 291 Churchill Road, Prospect 5082; freecall 1800 818882, or fax (08) 8269 4460. VAF also has a Web site at **www.VAF.com.au**, and can be contacted by e-mail at **info@vaf.com.au**.

Big screen CTV sets from Panasonic



Panasonic has launched two new 78cm CTV models to increase its presence in the large screen TV market. The first of the two models is the TC-78SS71A, which is being produced in Australia at Panasonic's manufacturing plant in Penrith on the outskirts of Sydney. It is a stereo TV with a super flat and black screen, a sound output of 24W and personal preference settings for both sound and picture.

The second and flagship new model is the 33GF85X (pictured), which is being imported from Japan. This is again a deluxe stereo model with a super flat and black screen, and offers a host of state-of-the-art features. To deliver superior sound it has four speakers arranged around the screen including side speakers, a centre channel speaker below the screen and a subwoofer above, collectively fed with 37W of audio.

The TX-33GF85X also includes a Digital Surround Processor (DSP), which helps create a true-to-life listening environment with a choice of Stadium, Hall or Cinema modes. An Auto Sound Equaliser ensures that the sound level remains constant from program to program.

The new model also has an advanced form of Picture-in-Picture which not only allows the user to watch two programs at once but can display up to four sub-screens to see what is showing on other channels. Sub-screens can also be shown as still images to capture a particular important moment. This feature is expected to appeal to sports fans.

The Panasonic TC-78SS71A and TX-33GF85X are available from leading electrical retailers for RRP's of $3299 and $4299 respectively. For further information circle 140 on the reader service card or contact Panasonic's Customer Care Centre on 132 600.

'Powerblaster' mini CD systems from Panasonic

Panasonic has recently launched two new portable CD Radio Cassette Recorders, the higher featured of which is claimed to have the highest sound output of any compatible product on the market.

The new RX-DT37 'Powerblaster' is able to achieve its high sound output with a high power amplifier which gives it an output of 240W (PMPO) via the 100mm speakers.

The RX-DT37 also has dual cassette decks, four preset equaliser settings, digital tuner and remote control.

The second new model is the RX-DS11 CD Radio Cassette, which has an output power of 30W (PMPO) via its 100mm speakers. The RX-DS11 has a single CD, single cassette and analog tuner.

The sound of both models is enhanced by Panasonic's XBS (eXtra Bass System) and MASH single-bit DAC for improved CD output.

Panasonic portable audio products are available from leading electrical retailers. The RX-DS11 has an RRP of $199 while the RX-DT37 is $329.

For further information circle 147 on the reader service card or contact Panasonic's Customer Care Centre on 132 600.

'World's first MPEG Camera' from Hitachi

Hitachi Australia has released details of the world's first Moving Picture Experts Group (MPEG) video camera, expected to be available in Australia later in 1997. The MPEG camera, which allows for realtime compression and full-motion video, will ship complete with seven software applications, allowing PC users to easily transfer recorded video to a PC and use the PC to produce, edit and view full motion videos.

Hitachi sees significant interest for the MPEG camera coming from Internet users wanting to include full motion pictures on their home pages, as well as companies using the camera for presentations and training on and off the Web. Hitachi also claim that the camera is simple to use and is well within the budget of many home users.

The camera weighs only 540 grams, significantly smaller than a conventional camcorder. It records video and audio in MPEG-1 format and stores the data in folders on a 260-megabyte PC Card (Type III) hard disk within the camera itself. The camera can store 20 minutes of full motion video or about 3000 still images at 704 by 480 resolution, and up to four hours of audio.

The recorded full motion video or still photos can be viewed on the camera's 1.8" LCD screen. The camera can also be directly attached to a TV for instant viewing, or connected to a PC, either through the supplied ISA interface board or, alternatively, by plugging the camera's PC card disk drive into a spare PC card slot on a computer to directly read the files.

The camera is fitted with a 6X zoom lens and comes complete with an infra-red remote control. The lithium-ion battery provides approximately 40 minutes of recording before a recharge is necessary.

The camera can also record still pictures in Joint Picture Experts Group (JPEG) format, with or without audio data in MPEG audio format. A speaker is provided in the camera for instant audio playback.

The Hitachi MPEG camera is expected to be available in volume in Australia late in 1997. Price at the time of going to press was not available, however suggested retail price in Japan is 248,000 yen.

For more information circle 141 on the reader service card or contact Hitachi Australia at 13-15 Lyonpark Road, North Ryde 2113; phone (02) 9888 4100 or fax (02) 9888 4188.

Big screen TV projector

Mitsubishi Electric claims its new video projector is likely to prove not only the ultimate in home theatre, but a useful business tool for home-based and other small businesses. Capable of projecting an image up to 762cm (300") in diameter, the projector can create an image which is almost 10 times larger than current large screen colour televisions.

Claimed as Australia's first projector using liquid crystal polymer composite (LCPC) technology, the model LVP-G1E has an extremely bright image because unlike conventional projectors, it does not require a polariser and thus uses light more efficiently. It has three image panels and a 250W metal halide lamp, and offers an image brightness of 600 ANSI lumens. Image resolution is 640 x 480 x 3, with 1.67 millions of colours capability.

The projector is multi-system compatible (NTSC, PAL and SECAM) and can connect to a variety of computer platforms (e.g., VGA, Mac 13", NEC 98). Other features include a manual 15X zoom lens, inbuilt stereo speakers and remote volume control.

The Mitsubishi LCPC Projector has an RRP of $10,999 and is available from selected electrical retailers. For more information circle 143 on the reader service card or contact Mitsubishi Electric on 1 800 811 212. ❖

BOSE WAVE RADIO

For this month's review, Louis Challis had the opportunity to check out the Wave Radio, from audio innovator Bose Corporation. Compact and stylish, this is no ordinary AM/FM stereo radio — Bose has taken advantage of the technology built into its Acoustimass and Wave Cannon systems, to create a unit whose performance is comparable with much larger hifi systems...

My earliest memories as a young child living in suburban Sydney during and immediately after the Second World War include listening to the family radio. It provided the sole element of electronic entertainment in my parents' house. The radio console resided in our living room, with its seven-valve receiver chassis in the top, and a large 12" electrodynamic speaker installed in the base. The radio provided an excellent performance, but more significantly, I have fond recollections of its warm rich sound.

Long after the War had ended, and following the release of microgroove recordings, my father bought a Kreisler console radio incorporating a record player. My family, like many others, then broadened its residential entertainment to add record playing to its repertoire.

With the advent of television in Australia in 1956 the nature of home entertainment changed dramatically. Radios and even record players were immediately relegated to a second order ranking. Quality car radios and good receivers, or tuners in hifi systems, were in minimal demand. Those radios that were manufactured in Australia and the majority of imported radios were primarily small transistor radios, which were either comparatively scruffy or were so expensive that few could afford to buy them. As you will note, nothing much has changed in the intervening period.

The most insidious trend resulting from the down-sizing of radios and their cabinets has been the readily perceptible loss of their audio output's frequency bandwidth.

Nowhere is that more evident than at the low frequency end of the spectrum. Based on my measurements, most portable, bedside or clock radios have frequency responses which are hard pressed to do better than reproduce a 200Hz to 3kHz signal on AM, or 200Hz to 8kHz or 10kHz on FM. Whilst the FM stations transmit a stereo signal with a genuine 20Hz to 16kHz bandwidth, that signal is seldom heard, except when using a good FM tuner and matching quality loudspeakers.

Bose re-think

In the early 1990s Bose Corporation in America revised the radio scene. Whilst virtually all other manufacturers produced small radios (or clock-radios) whose sound potential was matched by their size, Bose decided that this was not the path it wished to follow.

The marketing team at Bose came to the conclusion that there was a market segment which sought a better performance, a matching superior appearance, and who were prepared to pay for the pleasure of having a product which sounded every bit as good as it looked.

Conventional acoustical theory leads one to the conclusion that, as a loudspeaker gets smaller, its ability to radiate and faithfully replicate low frequency sounds diminishes in proportion to the area of its diaphragm. Obviously, with appropriate equalisation a designer can compensate for that dimensional limitation. The problem is that, as you apply more low frequency bass boost, the amplitude of motion or linear excursion of the loudspeaker's diaphragm soon exceeds the loudspeaker's capability. When the excursion exceeds the loudspeaker's travel limits of linearity, the voice coil has a nasty habit of producing unacceptable levels of distortion. If you persist with such questionable habits, the loudspeaker will audibly complain — and more embarrassingly, is equally likely to suffer an early demise.

The R&D team at Bose had of course already developed their 'acoustic cannon' and 'Acoustimass' systems, which I consider to be among the most outstanding electro-acoustic developments of the 1980s.

The underlying theory of those concepts is that the low frequency performance of a loudspeaker can be dramatically enhanced by loading either one or both sides with a quarter-wavelength stub, or

one or two separate tuned speaker enclosures which display comparable characteristics. The tuned element makes it possible to either boost the low frequency response over a narrow band, or with two tuned circuits, to provide a double-humped bandpass response with matching improvement in overall bandwidth.

This approach simultaneously achieves two major technological advances. The first and foremost advantage is the loudspeaker system's ability to produce a low frequency signal whose intensities are disproportionate to the size of the system.

The second and equally critical advantage is that the Bose system is able to produce normal sound levels with significantly lower input power levels. In effect, the improvements are in direct proportion to the mechanical 'Q' of the system in much the same way that an electrical 'Q' of a tuned circuit achieves comparable advantage.

Bose Corporation's international patents discouraged illicit infringement of their technology. Notwithstanding, I am aware of at least two European loudspeaker manufacturers who tried to circumvent those patents — but in the end, desisted because of the spectre of court penalties.

Bose really capitalised on its new technology with the bass driver module of its Acoustimass loudspeaker systems. The Acoustimass systems are one of the few loudspeaker systems that can truly claim to be a 'legend in their own lifetime'. But apart from using the technology in the Acoustimass systems and the Corporation's professional driver system, Bose appeared to be temporarily stalled in capitalising on its new technology.

However all that changed four years ago. In May 1993 Bose released the first of its wave radios. The design philosophy underpinning the 'Wave Radio' concept was its ability to reproduce the original sound spectrum with an extended low frequency response — one which simply could not be matched by any other comparable product in the market place.

Low profile

On first examination, the Wave Radio is notable for its relatively low profile and unusually shaped plastic cabinet. You are aware of its unusual almost-trapezoidal shaped cabinet, with a smoothly contoured slotted front panel, which lacks the squareness and 'boxiness' of its competitors.

A large plasma display is centrally positioned at the upper edge of the front panel. The numerical components on that display provides TIME, indicate AM or PM, as well as four sets of alarm information. The word SLEEP lights up to indicate when the SLEEP MODE has been selected.

When switched to the radio mode, the numerical display shows:

- The station's frequency
- Current time
- Wake-up time
- Time remaining before automatic shut-off
- Volume setting as a relative decibel level

Other displays show whether the input is auxiliary, FM STEREO, or AM; and VOL, for volume, while the output sound level is being adjusted. It also displays the word SEEK while the radio is searching for a strong signal, and PRESET when you are actually presetting a station's frequency.

Only six presets are provided for AM and six for FM stations. I realise that many prospective purchasers may regard six presets per band as being inadequate, but it appears that most marketing investigations reveal that the majority of people only regularly listen to a relatively small number of radio stations. Consequently a choice of six FM and six AM presets should satisfy the day-by-day requirements of the majority of prospective users.

All of the pushbutton controls on the top of the cabinet are clearly labelled and sensibly laid out. Only the ON/OFF power switch is brown, whilst all the other switches are the same beige colour as the cabinet.

Two double-width pushbuttons are provide for increasing or decreasing the output volume. Six numbered preset buttons are provided for selecting preset stations. Another two double-width pushbuttons are provided for searching up or down the frequency spectrum.

Three separate buttons are provided for ALARM SET, ALARM MODE and CLOCK SET. The ALARM MODE button allows a selection of either turning on the radio or sounding a tone, which is indicated by its own special indicator light. Either way, when the alarm goes off, either the radio sound or the tone will gradually increase to the level that you have preset.

If you have set the alarm to sound the tone, and you wish to listen to the radio following the alarm going off, then pressing the ALARM MODE button eliminates the audible tone. You can of course select both tone and radio to operate simultaneously when the alarm goes off. Should that happen then you can deactivate the tone by touching the very large SLEEP/SNOOZE button at the front of the control panel. The radio incorporates a second alarm option, which allows you to set a second alarm independent of the primary alarm.

Tiny remote

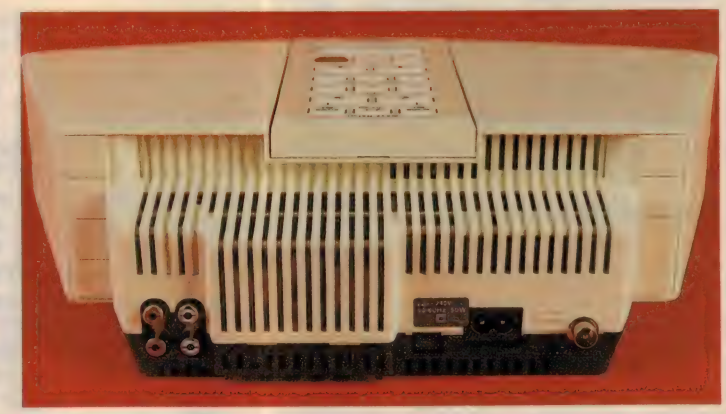
All of the major controls on the radio's upper cabinet surface are replicated on the credit-card sized Wave Radio Remote Controller. Surprisingly, and unlike the Lifestyle Music System's remote controller, this unit employs an infra-red transmitter rather than an RF transmitter. In order to use this remote controller, you have to be positioned so that you (and it) can see the Wave Radio's front panel.

The remote control's operating range exceeds 10m, and its angular range of dispersion covers at least a 150° arc in the horizontal plane in front of the receiver.

The Wave Radio's back panel has two input sockets for the Auxiliary input and two output sockets for the radio's output. The output socket's level is controlled by the radio's volume control setting. A 75-ohm coaxial input socket is also provided for the FM tuner's aerial input.

Complex internals

When I opened the Wave Radio's cabinet, I discovered that Bose have taken considerable trouble in order to achieve the complex range of electronic and acoustical functions which the manufacturer's literature claims that this radio will provide. A large printed circuit board is located in the black plastic base of the cabinet. On examination of its circuitry, the separate sections of the two radio tuners, and stereo amplifier's output circuitry are clearly identifiable.



At the rear are the auxiliary audio input and line output connectors (lower left), the power input and the FM antenna input (lower right).

More significantly, the quality of the premium components and quality of its design are clearly identifiable. The output amplifier's heatsink is located close to the rear of the printed circuit board, in a well ventilated section of the receiver. All components are clearly identified, and the only thing lacking was a circuit diagram in order to make full use of the information therein.

The radio's power transformer is well constructed, carefully screened, and has also been correctly positioned at the rear of the cabinet where it is optimally ventilated. A battery compartment is provided for three 'AA' batteries to back-up the preset, and clock or alarm times which have been logged. In the event of a power failure those memory functions and times are thus retained.

The designers appear to have taken more trouble than I would have expected, as even the ferrite antenna has been care-

fully buffered by a foam rubber capping. This rubber capping reduces the likelihood of damage to the ferrite, or electro-acoustic feedback from the speaker's low frequency rear venting structure, which is located immediately above.

By opening up the cabinet, I had hoped that I would be able to examine the speaker enclosure design more closely. Alas! Bose have carefully encapsulated the speaker cabinet, and in order to open it and remove the cover I would have needed special tools. Notwithstanding, the shape of the low frequency venting structure is indicated by indentation in the plastic moulding, and these provide the clues as to the nature of the design philosophy which was adopted.

On closer examination, one observes that the two 50mm diameter speaker drivers on each side of the cabinet have a distinctly different appearance. One driver provides both low and high frequency output. The other driver appears to provide only a high frequency output. In keeping with other subwoofer sound systems, you only need one source for the low frequency energy — which is lucky, because otherwise the cabinet would be considerably larger.

The low frequency venting port is located on the right-hand side of the cabinet. This port and the moulded convoluted section of ductwork behind it provide the mechanism through which the minuscule bass driver achieves its remarkable extended low frequency response.

On the instruments

The presence of the auxiliary input sockets (as well as the radio tuner's output sockets) provided me with an unexpected bonus when it came to evaluating the Wave Radio's objective performance.

My first thought was to place the radio in our anechoic chamber and measure its frequency response in the same way that I would measure a loudspeaker's on-axis response. As I pondered that issue for a while, I realised that the two speakers were pointing in slightly different directions, and each fulfilled a different role when used in a semi-reverberant bedroom or living room situation. As a consequence, I decided to adopt a different approach.

In order to assess its overall performance, I decided to provide an input signal which used a swept narrow band of pink noise, with a 31.5Hz bandwidth. I then measured the Wave Radio's response at a distance of 1m, which would be representative of the distance at which it would be monitored if it were next to a bed in a semi-reverberant room.

The resulting level recording revealed that the Wave Radio produces a double humped response that is within +/-6dB between 55Hz and 300Hz. The rest of the spectrum lies within +/-6dB from 400Hz to 18kHz, which is not bad considering the size of the drivers and their disposition in the cabinet. Had I used a sinewave for the test signal, the results would have been more graphical, but regrettably would have been considerably harder to interpret.

Inside the box, most of the electronics is tightly packed and mounted on the baseplate. The speakers are enclosed in the sealed top moulding assembly.

I repeated the exercise with a pink noise input signal to measure the Wave Radio's 1/3-octave band pink noise response. An examination of the two sets of results confirmed that the Wave Radio achieves a remarkable extension of its low frequency output response. Its effective lower output limit extends below 50Hz. When one considers the size of the cabinet, this response simply cannot be sneezed at.

It was obvious to me that with such a small cabinet incorporating minuscule 50mm diameter drive elements, there was a strong likelihood that I would discover some other performance limitation. With that thought in mind, I proceeded to evaluate the practical upper output limits of the system at three test frequencies of 100Hz, 1kHz and 6.3kHz. The parameter I sought to evaluate would be determined by the power output level where the total harmonic distortion level would be 3%, when measured at 1m from the front face of the radio.

At 100Hz, the 3% distortion level conformed to an output level of 72dB, which is somewhat lower than I would have expected. By contrast, at 1kHz the output level was a very healthy 95dB. At 6.3kHz the output level had dropped back to a modest 85dB.

Whilst evaluating the output distortion characteristics, I expanded my assessment to examine the tone burst response of the radio's speaker on a CRO. There were some signs of ringing identifiable in the audible output. The four bands in which the ringing was observable occurred with test signals at 70-72Hz, at 130Hz, at 2.3kHz, and to a lesser degree over the 3-5kHz region.

As the Wave Radio will be most frequently used in the FM stereo mode, I measured the FM tuner's frequency response. The tuner's frequency response is essentially flat (within +/-1dB) from 20Hz to 11kHz. Beyond that frequency, the output level gently droops, so that by the time it reaches 16kHz it is down by 6dB.

The FM tuner's input sensitivity is 17dBf, which is reasonably good. More significantly, the tuner's signal-to-noise ratio is better than 65dB, with a 65dBf input signal. I was impressed by the FM tuner's excellent response, so I proceeded to evaluate the AM tuner's response.

Surprisingly, the AM tuner's response is wider than Bose claims in its literature. The -6dB points in the frequency response are at 40Hz and 4kHz. Although better than claimed, that bandwidth is still only marginally better than that provided by most other radios. It certainly falls short of what a more discerning purchaser would really like to be offered.

Trial by jury

By that stage of my evaluation I realised it was time to take the Wave Radio home and subject it to a 'trial by jury'.

When I placed the Wave Radio on top of my racked music stack, I discovered that with its own tied-up folded dipole antenna stuck into the socket on the rear panel, I was able to pick up at least a dozen FM stations with more than adequate signal to noise ratio. With the dipole antenna unfolded and fully extended at both ends, I was able to

pick up all of the FM stations I had previously heard, together with at least four new and weaker ones.

On AM the receiver worked passably well. However, in order to achieve optimum reception on lower powered or distant stations, the Wave Radio had to be rotated accordingly.

On both FM stereo and AM, the Wave Radio provided a signal which was on par with my existing racked system in terms of its signal-to-noise characteristics. Surprisingly it was every bit as good in terms of its subjective audible quality.

This was a trifle hard for my listening team to accept, as the differences in size are extreme. I decided that the best way to evaluate the audible differences would be to feed the Wave Radio auxiliary input with signals from my CD player.

I watched my panel members' faces as I explained what we were about to do. At first they were somewhat incredulous at my stated purpose, and that incredulity expanded and was soon displayed by their facial expressions as a I started to play music through the Wave Radio.

One panel member's response was, "Where is the other speaker?" When I patiently explained that there was no other speaker system, the quizzical looks which I received were indirect confirmations of the Wave Radio's performance.

I set up an 'A-B' test involving the Wave Radio for the 'A' module, and my normal monitoring system for the 'B' module. I played some new discs which provide a balance between the normal low frequencies, and the rest of the audible spectrum.

The first disc I used was a recently released Masterworks Heritage disc, featuring the famed Russian bass baritone Alexander Kipnis. The original 78rpm records have been re-processed to produce a CD featuring 'Opera Arias & Songs' (Sony Classical MHK 62354). The last track on this CD is noteworthy and something of a rarity. It features Kipnis' 1929 recording of the aria 'In diesen heil gen Hallen' from Mozart's *The Silver Flute*. I played that particular track through both the Wave Radio and my monitoring system. The results were astounding. My test panel's response was one of disbelief. Two of the members' responses were "How could this 'piddling' little radio provide such a remarkably good acoustic performance?"

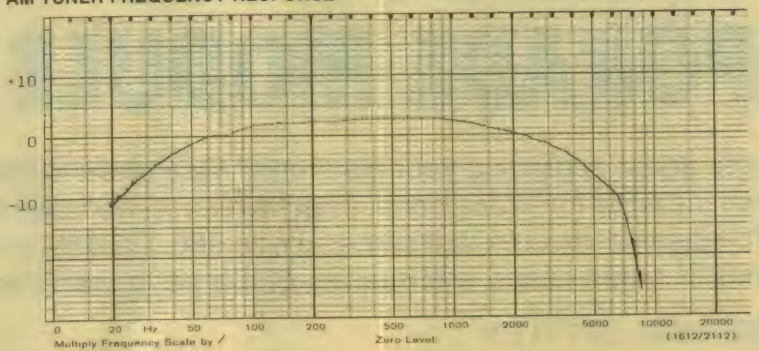
We progressed to something a trifle more difficult with Bartok's Concerto for Orchestra, with Esa-Pekka Salonen conducting the Los Angeles Philharmonic, (Sony Classical SK 62598). This is the only Bartok Concerto which I like, and its significance in this situation is that it displays the full range of orchestral instruments — important when evaluating the Wave Radio's performance.

The differences in audible characteristics between the Wave Radio and my monitoring system were immediately apparent. Notwithstanding, the differences were disproportionate to the size and cost of the respective systems. The only musical instruments whose performance fell well short of what I would describe as 'reasonable standards' were the drums. My test panel's response was an even greater degree of incredulity.

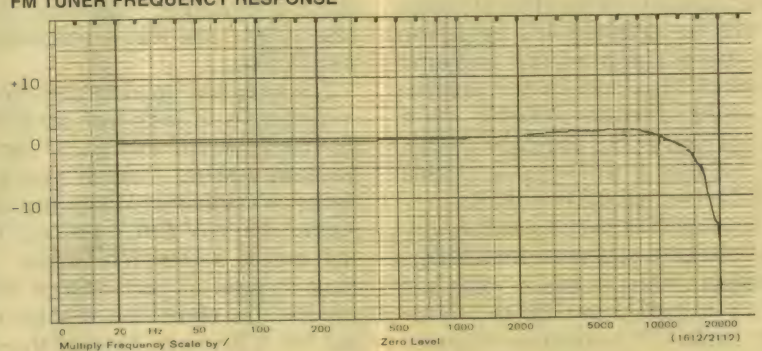
Finally we listened to my favourite soprano, Kathleen Battle. Her latest disc is 'Grace', in which she sings a potpourri of sacred music backed by organ, harpsichord, harp and the American Boy Choir (Sony SK 62035). Every track on the disc is a gem, and sung with a panache that few sopranos could match. The Wave Radio displayed her singing with a commendable quality of reproduction. The test panel was again impressed, to a sufficient degree that one member of the panel was already talking of buying a Wave Radio for her mother.

BOSE WAVE RADIO — TEST RESULTS

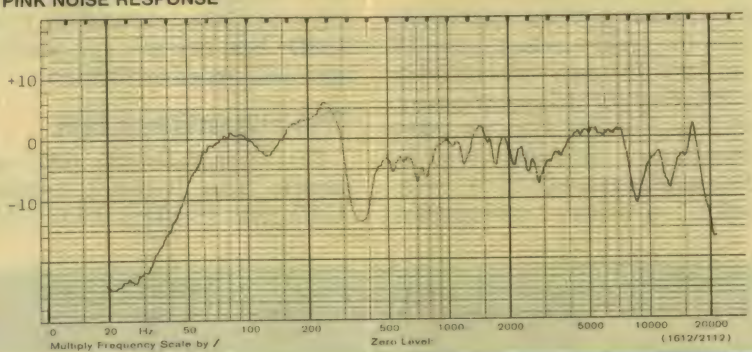
AM TUNER FREQUENCY RESPONSE



FM TUNER FREQUENCY RESPONSE



PINK NOISE RESPONSE



Bose Wave Radio

A compact but high performance AM/FM radio. Overall dimensions are 360 x 205 x 115mm (W x D x H), with a weight of 3.2kg.
Good points: Impressive, well balanced sound quality that completely belies its compact size — especially on FM reception or playing CDs. Better than average AM reception. Compact and elegant IR remote control.
Bad points: As a radio, it's certainly not cheap. For those who want good sound, and can justify the expense. Only six presets for FM and AM bands.
Price: $649 RRP.
Further Information: From Bose Australia. Call 1800 023 367 (freecall).

In summary

With a selling price of $649 (RRP), this is clearly not the radio to suit most pockets. It is however well suited for those of you who want a 'pint sized' radio which can reproduce a bedside sound quality which approaches that provided by your hifi system.

Once you hear it, even if you don't end up purchasing a Wave Radio straight away, it's more than likely that you will place it on your future birthday or Christmas 'wish list'. ❖

HYPERTEC'S 586 UPGRADE MODULE

Thought about upgrading your computer? One of the simplest and most effective upgrades is to replace the CPU for a faster one. For this review, we looked at the HyperRace 586 from Hypertec, a CPU upgrade module that can squeeze 586 133MHz performance from a standard 486 motherboard. In some cases, this can result in a performance increase of over 300%...

by GRAHAM CATTLEY

The architecture of the IBM PC lends itself well to replacing and upgrading almost every aspect of the computer with newer, bigger and faster components as they become available. As a result, upgrading your computer is often simply a matter of removing the lid and adding or replacing the new device.

For items such as memory or hard drives, this process can continue indefinitely; the problem comes, however, when you decide to upgrade your CPU to a faster version. Faster CPUs consume more current, and thus dissipate more heat.

To alleviate this problem, Intel decided to drop the supply voltage from 5V down to 3.3V for their newer CPUs, thereby reducing the dissipated power. A good idea, but one that left many motherboards at a dead end as far as upgrading was concerned. As a result, any Socket 1 or Socket 2 486 motherboard is limited to supporting only the older CPUs, and thus a maximum of a 486DX2/66.

The only real upgrade path for these computers is to ditch *both* the CPU and the motherboard and move on to a Pentium system. Even if you have a Socket 3 motherboard capable of supporting the 3.3V CPUs, you still hit the end stop at a DX4/100. Again, if you want a speed or performance increase you have no choice but to ditch the lot and buy a Pentium. Most of these later 486 motherboards support the 586 series of CPUs produced by Cyrix and AMD, but they are still limited to a maximum speed of 100MHz.

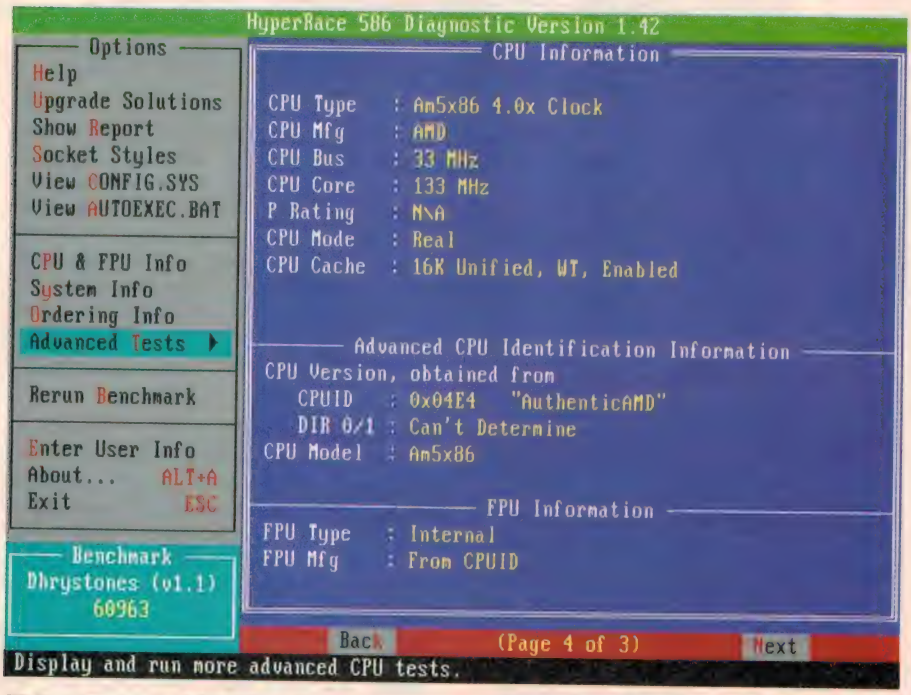
The HyperRace 586

The HyperRace 586 CPU upgrade module from Hypertec combines an AMD 586/133 with a 5V to 3.3V voltage converter in the one package, which overcomes the above problems and provides a significant performance boost, even for high end 486s.

The module consists of a small (46 x 46mm) square PCB on which is mounted an AMD 586 133MHz CPU, a 3.3V voltage regulator, a small amount of SMD support circuitry as well as a set of three configuration jumpers. The underside of the module contains an array of 169 gold plated pins that allow the module to inserted into any 486 169/238-pin PGA socket. It comes in an upgrade kit with a small CPU removal tool (to remove the original 486 from the motherboard) and a 72-page user's guide.

Also included is a 3.5" floppy disk containing ETDIAG, a small utility program that can produce a report on your current system. It will also run a Dhrystones benchmark on your system, so that you can compare your system's performance both before and after the upgrade.

One important point raised in the user's guide is that the upgrade doesn't work with 486 SLC and DLC processors, nor will it replace DX/50 CPUs. (Note: this is the 486DX/50, *not* the more popular 486DX2/50 CPU.)



This screenshot is taken from Hypertec's ETDIAG, a simple diagnostic/benchmark program that can give you an idea of the upgrade's performance.

Installation

For the purpose of this review, I decided to install the HyperRace 586 CPU upgrade in my work machine, a 486DX2/66 with 16MB RAM, and a 340MB hard drive.

The user's manual supplied with the upgrade is surprisingly well written. It covers every aspect of the entire changeover procedure in a clear and concise manner, and leaves no room for errors in how to remove the old CPU and install the upgrade. This is a very important point, as I would imagine that many users would find this a nerve-wracking experience. The guide gives diagrams showing the various socket types and configurations found on most motherboards, and gives step by step

The HyperRace 586 upgrade contains a 5V to 3.3 voltage converter (lower left) which powers the AMD 586/133 CPU sitting under that tiny (1" square) heatsink. Because of its low voltage operation, the upgrade runs no hotter than a standard 486.

instructions all the way.

As I mentioned before, the upgrade contains a set of three jumpers that are used to configure the module so that it will run properly when installed on the motherboard. These three jumpers set: (a) whether the upgrade is to be installed in a CPU or Overdrive socket; (b) if the upgrade runs in clock tripling or clock quadrupling (x3 or x4) mode; and (c) whether the upgrade's own 16KB internal cache is set to write-through or write-back.

The first two jumper settings are explained quite clearly in the manual, but the write-through/write-back jumper wasn't mentioned in the installation section of the guide, so I left it in its default position of write-through. Of the other two jumpers, I selected the CPU socket position (it was the only one on my motherboard) and x4 clocking, which by my calculations would bring my system up to 133MHz.

Having removed my original CPU (I didn't need the little removal tool as my motherboard used a ZIF socket), I then plugged in the upgrade module, shut my eyes, and switched on the computer...

Well, no smoke ensued, and the computer seemed to boot normally; the only problem was that the BIOS boot screen reported an '80486DX2 CPU at 100MHz', not 133MHz as I'd expected. Curious, I ran ETDIAG to compare its benchmark against the one I had run before the upgrade.

Unfortunately, the program seized up halfway through the test, and I had to reset the computer. On this second (warm) boot, the BIOS reported that it had found an '80486DX2 CPU at 132MHz'. Even more curious, I ran ETDIAG again, and this time it succeeded in running and reported a Dhrystones rating of 60860 (as opposed to 33705 for my original processor). Unsure as to why the computer reported a lower speed when first booted, I switched off the machine and started again. After several cold and warm boots, I found that on a cold boot, the BIOS would always report a clock of 100MHz, but on subsequent warm boots it would get it nearly right, and report 132MHz. (Why 132 and not 133? Don't ask me, I don't know!)

Taking all this in my stride, I decided to try the upgrade in some real-life tests — benchmarks are all very well, but they don't always prove very much.

Big job

To start with, I tried rotating a 32-bit 5.5MB uncompressed TIFF image by 90 degrees, which is a big job for my old DX2/66 system, and it took a total of 28 seconds to complete the procedure. With the HyperRace installed, and with the BIOS reporting '100MHz', it took 21 seconds, which equates to quite a reasonable 30% speed increase. After warm-booting the machine and trying again at '132MHz', it still took 21 seconds.

Converting the image to CMYK took my old system 33 seconds, while the upgrade managed it in just 20, again regardless of the speed reported by the BIOS. Importing a very short but highly complex EPS file took 56 seconds on my DX2/66, but with the upgrade installed, it only took 18 seconds — a huge speed increase of over 300%.

This goes to show that, while the HyperRace CPU is extremely fast, any bottleneck in your system (in my case, shortage of RAM) will still slow things down significantly. The big TIFFs required large amounts of data to be thrown around the system, involving a lot of actual memory access and associated disk swapping, slowing the process down considerably. The little EPS file, on the other hand, although processor intensive, didn't involve shifting large amounts of data, and so could really scream along.

And what about the 100/132MHz CPU speeds reporting by the BIOS? Well, after contacting Hypertec we came to the conclusion that it was simply a case of the BIOS getting a little confused on power up, and mis-reporting the CPU speed — the tests performed previously seemed to support this theory as well. (For the sake of completeness, I tried running the upgrade in its x3 mode and found that the BIOS reported a 'DX4-S at 100MHz'. This reinforced the 'confused BIOS' theory, as it looked as though it was recognising the CPU correctly at the lower speed.)

Trial offer

It is not surprising that Hypertec are proud of their HyperRace 586 upgrade, but what *is* surprising is that they offer a 30-day money back guarantee on the upgrade module if you aren't happy with the performance it provides. This is the first time I've come across a company willing to provide this sort of reassurance on such a low-level system component. I think it also shows the confidence that they have in their product, and that you can expect to get a real, practical performance increase out of your system.

To top it all off, Hypertec provide free technical support on a toll-free number, to help with any problems in getting the upgrade up and running.

So no matter what 486 CPU you are running at the moment (with a few exceptions), you really can't go wrong by installing the HyperRace 586. With this upgrade, almost any 486 system is likely to be transformed into a very respectable computer indeed; and at $199, it could well be the most cost effective upgrade around today. ❖

HyperRace 586 upgrade

Good points: Cheap, easy to install, effective.
Bad points: Doesn't work with some 486 models
RRP: $199.
Available: From most major computer suppliers, or contact Hypertec directly on (02) 9857 9900 or freecall 131307, to take advantage of their 30-day free trial.The company's street address is: Hypertec Pty Ltd, 61 Talavera Rd., North Ryde NSW 2113. Their postal address is: PO Box 1782 Maquarie Centre, North Ryde NSW 2113.

ICOM'S IC-R10 WIDEBAND RECEIVER

The latest addition to Icom's impressive range of products is the IC-R10, an updated version of its very popular IC-R1 pocket sized wideband communications receiver. It features additional reception and scanning modes, a 'bandscope' function displaying nearby signals, a built-in 20dB attenuator and the ability to be programmed from a PC using the CI-V interface.

by JIM ROWE

Back in the October 1990 issue I reviewed Icom's then new IC-R1 'mighty midget' receiver, which generated a lot of interest. It was the first pocket sized wideband communications receiver, and delivered surprisingly good performance when one considered the compromises that Icom had to make, in order to squeeze so much into such a miniscule case. Since then I understand it's been very popular.

Time marches on, though, and Icom has now released the IC-R1's successor, the new IC-R10. While similar in styling the new model is actually a little larger than the earlier model — measuring 130 x 58.5 x 31.3mm, and weighing in at 310g — which is probably a good thing, because the IC-R1 was right on the borderline of being too small for convenient use.

The slightly larger case size has allowed the designers to provide more control buttons (now 20, instead of 18), and to make them a little larger and 'finger friendly'. The speaker is also a little larger (36mm), for better sound. Apart from that things are much the same; there's still a rotary tuning control at the top, together with the volume and squelch controls (now concentric).

The tuning range of the new receiver is similar to its predecessor, reaching to 1300MHz at the high end although only down to 500kHz at the low end (the IC-R1 went down to 100kHz). However there's now a wider range of reception modes; as well as the AM/FM/WFM modes provided on the IC-R1, you now have USB, LSB and CW modes for greater 'receivability' on the HF bands.

There's a wider range of tuning steps, too. You can now choose any of 15 preset step sizes, from 100Hz to 100kHz, or program a custom step size of your own (from 100Hz to 999.9kHz, programmable in 100Hz increments). As before it's also possible to set the rotary control steps to larger increments as well (1, 10 or 100MHz). As the front end of the IC-R1 had a few limitations in terms of image and intermodulation product rejection, Icom's designers have redesigned this section for the IC-R10 and given it improved bandpass filtering. The triple-conversion system has also been revamped, with a first IF of 429.1MHz now used when you're receiving signals between 340MHz and 1GHz. For other frequencies the original first IF of 266.7MHz is used. The second and third IFs are still 10.7MHz and 455kHz.

In addition to these changes, the IC-R10 now also incorporates a switchable 20dB RF attenuator, to improve large-signal performance.

Another new and very nice feature is a real-time 'bandscope' function, whereby the bottom third of the LCD display becomes a simple but very useful panoramic display, showing the presence of nearby signals either side of your current tuning frequency. Icom claims this is the first time such a facility has been provided on a handheld receiver, and it's a welcome addition.

The bandscope essentially displays 11 small graphics blocks in a horizontal row, with a narrower centre block representing the current tuning frequency and five wider blocks on either side representing the adjacent tuning-step 'channels'. The height of each block represents the amplitude of any signal present in that channel. When the tuning step size is set to greater than 20kHz, the bandscope automatically limits its passband width to +/-100kHz, but otherwise the two are linked — very handy.

The 'bandscope' displays variable-height blocks along the bottom of the LCD, representing signals below and above the current frequency.

The IC-R10 now has a total of 1000 memory channels (compared with 100 for the IC-R1), and the channels can be given eight-character names, for easier identification. Channels can now also be grouped into banks, and each bank given a 10-character name. A non-volatile EEPROM is used for memory, ensuring that your memory data is not lost if the receiver's battery goes flat.

On the scanning side, there's now a wider range of scan modes, including an intelligent 'SIGNAVI' mode which skips clear frequencies within +/- 100kHz of a paused frequency, to the next 'real' busy channel. The IC-R10 also incorporates Icom's proprietary VSC (voice scan control) function, which pauses scanning only when modulated signals are present.

Other new features on the IC-R10 include a noise blanker and auto noise limiter, plus a basic CI-V serial data interface which allows communication with a PC (via an optional adaptor) and also 'cloning' memory contents from one IC-R10 to another (via an optional cloning cable and software).

In short, the IC-R10 is significantly enhanced over the previous model, and a surprisingly capable communications receiver.

How it performs

As you can see from the basic spec panel, the rated sensitivity of the IC-R10 is well below 1uV for FM and SSB/CW, and below 2.5uV for WFM and AM. We checked the sample receiver on the bench at quite a few frequencies, and got figures that fell comfortably within these specs. A few quick checks of the selectivity in the various modes also confirmed the specs in that regard.

We also tried out the receiver in action, with both the 'rubber ducky' antenna supplied and a couple of external antennas — a balanced long-wire antenna for MF and HF, and a discone for VHF and UHF. As expected it gave a very good account of itself, even with the little rubber ducky antenna. And its performance with the larger antennas was significantly more satisfying than for its predecessor.

Notwithstanding its tiny size, then, the new Icom IC-R10 is a very impressive and surprisingly practical MF-to-UHF wideband communications receiver. Not to mention its excellent performance as a scanner, of course. The quoted price is only $764.40 (RRP), too, which allowing for inflation in the last six years is probably a little less in real terms than was the IC-R1. ❖

BASIC SPECS

- Receive system : Triple superheterodyne
- Intermediate freq. :
  - 1st: 266.7 MHz (340.0000–999.9999); 429.1 MHz (except above freq.)
  - 2nd: 10.7 MHz
  - 3rd: 455 kHz
- Sensitivity (typ.) : (except spurious points)

Freq. (MHz)	FM	WFM	AM	SSB/CW
0.5– 4.9999	0.5 µV	—	1.6 µV	0.4 µV
5– 74.9999	0.32 µV	—	1.0 µV	0.25 µV
75– 199.9999		1.0 µV		
200– 339.9999	0.45 µV	2.2 µV	1.6 µV	0.4 µV
340– 699.9999	0.35 µV	1.3 µV	1.4 µV	0.32 µV
700– 799.9999	0.79 µV	2.0 µV	2.0 µV	0.63 µV
800– 899.9999	0.5 µV	1.6 µV	1.6 µV	0.4 µV
900–1300.0000		—		

*FM and WFM are measured at 12 dB SINAD; AM, SSB and CW are measured at 10 dB S/N.

- Mode : FM, WFM AM, USB, LSB, CW
- Tuning steps : 0.1, 0.5, 1, 5, 6.25, 8, 9, 10, 12.5, 15, 20, 25, 30, 50, 100 kHz or user-programmable (0.1–999.9 kHz/0.1 kHz steps)
- Power supply requirement : 4.8 V DC (4 AA (R6) Ni-Cd cells); or, 4.8–16 V DC acceptable (negative ground)
- Current drain (at 13.5 V DC):
  - Rated audio: 180 mA typ.
  - Standby: 110 mA typ.
  - Power saved: 38 mA typ.
- Usable temp. range : –10°C to +50°C (+14°F to +122°F)
- Antenna connector : BNC (50 Ω)
- Scan speed :
  - Programmed: 16.7 channels/sec.
  - Memory: 6.25 channels/sec.
- Selectivity :
  - SSB, CW: More than 4 kHz /6 dB
  - AM, FM: More than 15 kHz/6 dB
  - WFM: More than 150 kHz/6 dB
- Audio output power : More than 120 mW at 10% distortion with an 8 Ω (at 13.5 V DC) load

Icom IC-R10 Receiver

An improved pocket sized wideband communications receiver, covering from 500kHz to 1300MHz and offering AM, FM, WFM, USB, LSB and CW reception modes.

Good points: Improved front end, more reception modes, more memories (1000), 'bandscope' panoramic display function, inbuilt RF attenuator.

Bad points: Nothing serious, considered in context.

RRP: $764.40.

Available: From Icom dealers. More information from Icom Australia, 7 Duke Street, Windsor 3181; phone (03) 9529 7582.

EFI UPDATE FOR CAR COMPUTER

In the March '96 issue, we presented a car computer design intended mainly for carburetted engines. The computer has now been updated to work with electronic fuel injected vehicles, without needing fuel flow sensors. Its 'virtual car dashboard' facility has also been refined, and these additions and some interesting applications of the computer are described in this article.

by ROBERT PRIESTLEY

Because it was originally designed for carburetted engines, the car computer described in March '96 needed a fuel flow sensor to give information about fuel consumption. With EFI and diesel engines however, two flow sensors are needed to measure the actual fuel used by the engine; one to measure fuel flow into the engine and the other to measure the fuel returned to the tank. Although this differential measurement system works and was incorporated into version 1.1 of the software, it's expensive (needs two flow sensors) and works only if the fuel flow rate is in the linear range of the flow sensors.

In an electronic fuel injected engine, a pressurised fuel line feeds the fuel injectors, which are controlled by a computer. A fuel injector is an electro-mechanical device which delivers precise amounts of fuel to the engine. By varying the injector's open time, the engine management computer can precisely control the performance of the engine.

So in an EFI engine, the car computer software can calculate the amount of fuel being used by simply measuring the time the fuel injector is open, which is what we've achieved in version 2.0 of the car computer. This also means you don't need fuel flow sensors, which makes the installation simpler and cheaper. In fact only five electrical connections are needed to install the EFI version of the computer.

As with the previous version, the EFI version is being offered as a kit and is identical to the original computer except for a change in the firmware. So for a full description of the car computer, see *EA* March 1996. Assembly instructions and a user manual are supplied with the kit.

Features

Here's a brief summary of the main features of the car computer. Its dimensions are 145 x 70 x 55mm and the kit is supplied with a black aluminium anodised case, customised membrane keypad and all parts.

The computer provides 22 calculations in metric, US or imperial format, displayed on a 24 x 2 backlit liquid crystal display. The distance calculations include distance travelled on a journey, distance remaining for the journey, trip meter and 'distance to empty' based on average fuel consumption.

The speed calculations include current speed, average speed and peak speed. The tachometer display includes RPM and peak RPM. The fuel calculations include fuel used on a journey, fuel remaining in tank, litres/100km, km/litre, average litres/100km, average km/litre, litres/hour (flow rate), total fuel cost and journey fuel cost.

The timer display includes a journey timer, and shows the time remaining to complete a journey, time remaining at average speed to complete a journey, and a trip timer. The computer also has a standing distance timer accurate to 1/100 of a second, typically used for 400m sprint timing, and an overspeed alarm to avoid those speeding fines.

Availability, Prices

This project is available as a kit from Oztechnics P/L, of PO Box 38, Illawong 2234; phone (02) 9541 0310, fax (02) 9541 0734. Oztechnics' Web site is at **http://www.oztechnics.com.au/**, or you can email **robert@oztechnics.com.au**.

Here are the prices:

Car computer EFI Kit V2.2	$240
Car computer kit V1.1 (requires flow sensor)	$240
Speed sensor (proximity switch)	$30
Fuel flow sensor	$95
Virtual dashboard + special EFI kit + RS-232 translator kit	$340
VB source code disk for virtual dashboard	$40
HC05 development system demo disk and source code samples	$5
HC05 user manual and Windows Acrobat Reader (three disks)	$10
Delivery charges	$10

Virtual dashboard

A virtual dashboard is a computer display simulating the instrumentation of a vehicle dashboard. To implement it, you need an IBM compatible PC, probably a laptop if you want it with you in the vehicle. The PC is linked via its serial port to the car computer.

The system therefore consists of a serial link between the car computer and a PC, an RS-232 level shifter, special car computer firmware and an application for Windows written in Visual Basic. The virtual dashboard screen (shown in Fig.1) displays all calculations simultaneously on the PC screen. It also displays the injector pulse width, the liquid crystal display sample time and sample number. The captured data is written into a file and can be played back at different speeds or loaded into a spreadsheet for analysis. The virtual dashboard software and a sample data file can be downloaded from the Oztechnics Web site. The source code is also available if you want to customise the dashboard.

The software

The car computer software was developed using the Oztechnics 68HC05 Development System. As a special offer to *EA* readers interested in learning HC05 code, the development system software, user manual and car computer HC05 routines can be downloaded for free from our Web site for further evaluation of the code. A disk of all the software is available for readers who don't have Internet access.

Comments are included in the sample listings to help you analyse them. Also available is a simple PC program which simulates an injector pulse using the parallel port of a PC. This program can

A screen dump showing the virtual dashboard. It shows fuel consumption, speed, RPM, injector information and more.

be used to bench test the car computer before installation.

The simulator which forms part of the HC05 software package can be used to run the routines on a PC, so you can see what actually happens in the microcontroller. The software is certainly worth a look at, and is an excellent way to get an introduction to microcontrollers.

We can't describe the software in detail, but as an overview, it generates 200 timer interrupts a second, which increments a timer counter every 5ms. This counter keeps track of all the various timers in the program, and co-ordinates the execution of the software and the keypad scan routine.

A useful routine to examine is how the computer calculates fuel consumption. Its 68HC705C8 microcontroller has an internal timer resolution of 2us when running with a 4MHz crystal. Considering that an injector pulse varies between 1 - 15ms, there is ample resolution for this application.

The microcontroller has a special timer input pin which is ideal for measuring pulse width, as it can be used to capture the exact time at which a transition occurred. This value is stored or subtracted from the previous measurement to calculate the open time of the injector. Once this is known, it is added to a total sample. The computer updates the fuel consumption each second, clearing the previously stored value at each update.

Another routine is how the computer calculates distance. The negative edge of each pulse from the speed sensor triggers the external interrupt pin on the microcontroller, generating an interrupt. This causes the software to service the distance subroutine, which simply adds or subtracts the distance calibration value to the various distance counters.

Installation

Installation is relatively straightforward. You will need to locate a permanent 12V supply, ignition switched 12V, ground and an optional headlights connection (for the backlit LCD). The back of the vehicle's digital clock is often a good source for these voltages. Once power is established, run a wire to an injector and connect it to the switched (grounded) side of the injector.

The last connection is to the electronic speedo of the vehicle. The computer needs an input of one to four pulses per wheel revolution. If the speedo produces more than four pulses per wheel revolution, you'll have to install a separate speedo sensor (also available), or divide the pulses using a digital divider circuit.

Note that the speedo output must be a 0-5V digital pulse. An inductive pickup is not directly suitable, as its output signal needs to be amplified and conditioned.

Calibration

The car computer must be calibrated before it can be used. To calibrate the distance, drive for a known distance, usually 1-5km, so the computer can count the number of pulses produced by the distance (speedo) sensor. The computer will then calculate how far the car travels for each pulse.

The fuel injector is calibrated by measuring the total injector open time for a known quantity of fuel. Typically you should use a full fuel tank when doing this calibration. The computer will calibrate itself over as many days or trips as necessary to use up a full tank. While in calibration mode, the LCD screen displays the last injector pulse in microseconds, pulse frequency and total accumulated injector time.

Applications

Although we call it a car computer, it has other applications. For example, we've have had reports of the car computer being installed in rally cars, boats, industrial machines, earth moving equipment and even an aeroplane. Any application requiring a counter, or where a quantity of liquid is to be measured can be accommodated.

An interesting application I was involved in concerns the car computer and the Internet. In April '96 I worked with a professional entrant in the Targa Tasmania car rally. This is an international event which attracts professional drivers from all over the world. The driver, Peter Ross, is an information technology specialist and he wanted a 'hi-tech' gadget to help him in the rally. I fitted the car computer into his Peugeot 205GTI, along with a video camera and a laptop PC that was connected via a mobile phone to the Internet.

The laptop captured the telemetry of the car computer and also grabbed video images via its parallel port. We used a low cost Quick Cam camera, gaffer taped to the navigator's sun visa, giving a bird's eye view of the race. This data was then uploaded onto the Internet, allowing Internet users anywhere in the world to experience the race from the cockpit of the Peugeot, via the virtual dashboard, telemetry and video. We believe this was a world first, and it was very exciting to watch the virtual dashboard speedo move towards the 200km/h mark. This 'virtual experience' can be downloaded from the Pannel Kerr Forster Web site.

The next step might be to digitise the cockpit intercom, but at 200km/h it's easy enough to imagine the conversation between the navigator and the driver! Incidentally, the car computer can be ordered as a kit from our Web site using a secured transaction process. ❖

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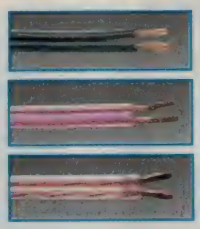

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HUBBLE GETS AN IMPROVED OUTLOOK

A few months ago, a team of NASA astronauts paid a new visit to the orbiting Hubble Space Telescope in the shuttle *Discovery*, and carried out some routine servicing — plus replacement of some of its hard-working scientific instruments. Here's a rundown on how mission STS-82 went, and what was achieved in upgrading the HST during the mission's five lengthy 'spacewalks'.

by KATE DOOLAN

In December 1993, the world watched enthralled as the crew of the US National Aeronautics and Space Administration (NASA) mission STS 61 repaired and upgraded the Hubble Space Telescope (HST), in a series of five dramatic spacewalks. Less than a fortnight after the dramatic STS 61 flight ended, scientists at the Space Telescope Science Institute in Baltimore, Maryland received the first images back from the 'new' Hubble — and were overjoyed with the results.

During a press conference held in January 1994, some of the upgraded images were released and caused a sensation with their clarity and beauty. It was a welcome change from the criticism that NASA had received since it was found that the HST was found to be myopic, soon after its launch in April 1990.

Since January 1994, the Hubble Space Telescope has been returning high quality images of our universe on an almost daily basis. As there have been over 110,000 observations made with the HST, I will only describe two of the observations that have been the most impressive and memorable.

In the lead up to the collision of Comet Shoemaker-Levy 9 with Jupiter in July 1994, Hubble was used extensively to track the comet on its path to destruction, provided magnificent images of the plumes caused by the impacts and the damage done to the areas hit. It also observed an enormous seismic wave that followed the impacts.

In November 1995, a spectacular image of the M-16 Eagle Nebula was released. What was so remarkable about this image was that there were pillars of gas measuring trillions of kilometres long, in a star birth region showing new born stars. The release of this image caused a sensation and wound up on the cover of *Time* magazine, which dubbed the image 'the scientific achievement of the year'.

'Oil & lube job'

Whilst the Second Hubble Space Telescope Servicing Mission aboard STS 82 in February lacked the drama of STS 61, it was a similar success — with the HST receiving an 'oil and lube job' along with the installation of several new scientific instruments which will increase and enhance Hubble's observations.

During five spacewalks, crew members replaced the Goddard High Resolution Spectrograph (GHRS) with the Space Telescope Imaging Spectrograph (STIS). As well, they replaced the Faint Object Spectrograph with the Near Infrared Camera and Multi Object Spectrometer (NICMOS). During the spacewalks other instruments were also augmented and repaired.

A spectrograph is an instrument that uses optical elements called gratings or prisms to separate the light gathered by the telescope into its component colours. The detailed changes in brightness of the light from colour to colour (or wavelength to wavelength) gives scientists data about the composition and other physical properties of the celestial source emitting the light, or of the intervening gas that absorbs the light.

The STIS is a 318-kilogram imaging spectrograph that covers a wavelength range of 115 to 1000nm (nanometres), in four bands. Three detectors are used: a cesium iodide photocathode Multi Anode Multi channel Array (MAMA) for 115 - 170nm, a cesium telluride MAMA for 165 - 310nm and a charge-coupled device (CCD) for 305 - 1000nm. All three detectors have a 1024 x 1024 pixel image format.

The STIS can provide unique and powerful spectroscopic capabilities for the HST, as it includes the capabilities of both existing spectrographs (the Goddard High Resolution Spectrograph and the Faint Object Spectrograph) and adds new capabilities through new technology. The STIS optical design features internal corrective optics to compensate for the HST primary mirror aberration.

The main advance in the STIS is its capacity for two-dimensional, rather than one dimensional spectroscopy. This makes it possible to record the spectrum of different locations in a galaxy simultaneously, rather than observing one location at the time. As a result, the STIS is more efficient at

A good example of the excellent images that the upgraded Hubble has been capturing recently: an excellent view of Mars, taken with the WFPC2.

obtaining scientific data than the earlier HST spectrographs.

STIS can accomplish both ultraviolet (UV) and Optical Imaging (115 - 1000nm) through the use of a complement of narrow and broadband filters. Its wavelength coverage in a single exposure is 15 to 35 times more powerful than that of the GHRS it replaced.

The STIS basic operation modes can support time integrated spectroscopy and imaging, time resolved spectroscopy plus imaging and targeting acquisition. STIS supports spectroscopy with resolving powers from 100 to 100,000 from the visible to the ultraviolet. Very high resolution data in the ultraviolet can be obtained by recording each photon event and transmitting it to the ground with location and an event time with an accuracy of up to 150 microseconds.

Some of the science that the STIS can undertake includes searching for black holes, studying quasar absorption lines, studying star birth and formation, plus performing spectroscopic mapping of solar system objects such as planets and their moons.

Scanning the near-IR

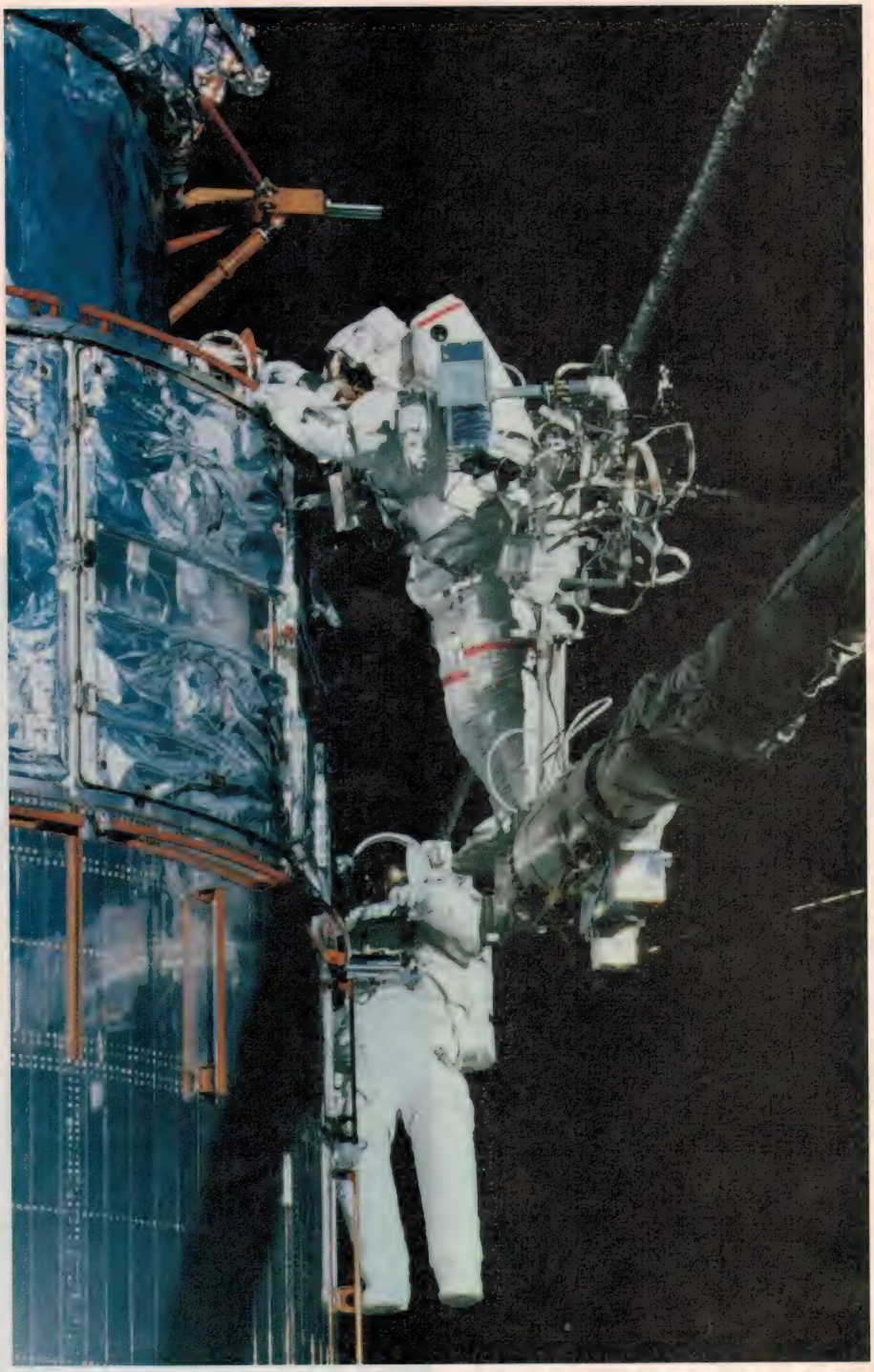
The near-infrared spectral region is now one of the cutting edges in astronomical research for studying the Universe's basic nature — which includes probing the past, present and future of the Universe plus determining how galaxies, planetary systems and stars form.

The Near Infrared Camera and Multi Object Spectrometer (NICMOS) now provides a new observing tool for Hubble, which will be crucial to answering questions about the Universe. The NICMOS, which weighs in at 370kg, will provide the capability for infrared imaging and spectroscopic observations of astronomical targets.

Infrared light is emitted in the electromagnetic spectrum at wavelengths that the human eye cannot see, because of their longer wavelength (lower frequency). NICMOS 'sees' light with wavelengths between 0.8 and 2.5um — whereas our eyes are limited to the range between 0.4 and 0.7um.

To study very distant objects, astronomers must observe larger, redder wavelengths in the 'near infrared'. NICMOS' near infrared capabilities will provide views of objects too distant for research by the current HST optical and ultraviolet instruments. The light from such objects is shifted in wavelength towards the infrared by the expansion of the Universe. As a result NICMOS can be used to study objects created near the beginning of the Universe.

Most celestial births, such as the birth of stars and planets, occur inside dark masses of dust and gas which obscure clouds of material that shielded these stellar views from HST's existing instruments. NICMOS will change that, because infrared light penetrates dust more easily than light at optical wavelengths.



STS-82 crewmember Mark Lee (top), attached to the end of Discovery's remote manipulator arm, patches some of the HST's worn insulation material during the final EVA. Astronaut Steven Smith is seen assisting.

NICMOS contains three cameras, each with a different spatial resolution. Camera 1 has the highest resolution, for very fine detailed pictures at the shorter near infrared wavelengths. At longer wavelengths Camera 2 has the next highest resolution for detailed pictures, while Camera 3 has a much wider field of view to encompass extended objects. Each camera has its own wheel of filters and optical components. Individual cameras can also operate independently whilst the other cameras are taking images.

NICMOS is also much more than a camera — it's also a spectrometer, a coronograph and a polarimeter. The filter wheels for Cameras 1 and 2 contain polarisers for polarimetric observations. The wheel for Camera 3 contains 'grisms', which are a combination of a grating and a prism for spectroscopy. Camera 2 also contains special covers for coronographic observations, which mask the light from a bright object to allow surrounding faint objects to be seen.

The sensitive infrared detectors in NICMOS must operate at the extremely cold temperature of 58K (Kelvin, the unit of absolute temperature). NICMOS keeps its detectors cold inside a cryogenic dewar containing frozen nitrogen ice. The dewar contains 108.5 kilograms of the liquid, and should cool the detectors for up to five years — longer than any previous space experiment. NICMOS is the Hubble Space Telescope's first cryogenic instrument.

Solid state recorder

The Solid State Recorder (SSR) has replaced one of HST's current reel-to-reel recorders. The data management of the HST includes three recorders, to store engineering and scientific data that cannot be transmitted to the ground immediately.

The SSR has no reels, no tape and no moving parts to wear out. It's similar in size to the reel-to-reel recorder it replaced, but can store 10 times as much information in computer memory chips until HST controllers at the Goddard Space Flight Centre (GSFC) in Greenbelt, Maryland command the SSR to play it back. The SSR stores 12GB (gigabytes) of data, whereas the tape recorder it replaced stored only 1.2GB.

The SSR has two memory units, each with arrays of six memory 'packages' of stacked 16MB (megabyte) chips. There are three arrays in a group. In the event of a failure in a chip, a single row of chips can be skipped over to leave the rest of the memory fully functional.

The Hubble Space Telescope communicates with the ground via NASA's Tracking and Data Relay Satellite System (TDRSS). The engineering information from the spacecraft systems and the science data from astronomical instruments can either be sent directly to the Space Telescope Operations Control Centre at GSFC, or recorded and played back at a later time.

New guidance system

A refurbished Fine Guidance System (FGS) replaced an existing unit which was showing signs of mechanical wear. There are three FGS units on HST, located at 90° intervals around the circumference of the telescope. Two of the FGS are used to point the telescope at an astronomical target and then hold the target in a scientific instrument's point of view. The third FGS can be used as a scientific instrument for celestial measurements.

The refurbished FGS is fitted with a new mechanism to accomplish better optical alignment. This allows the telescope operators to compensate for the changes due to on orbit conditions and optimise HST's performance by keeping the FGS more finely tuned.

One of Hubble's four Reaction Wheel Assemblies (RWA) has also been replaced with a refurbished spare. The RWA is part of the HST's Pointing Control Subsystem. Spin momentum to the wheels moves the telescope towards a target and maintains it in a stable position.

Work on the Magnetic Sensing System (MGS) on the Hubble during the first servicing mission required the STS 61 to construct protective covers for hardware using material that was available on the space shuttle. Some of this material has degraded in the space environment and this required the installation of more durable covers.

Crew chosen

In late 1995, it was publicly announced that Ken ('Sox') Bowersox would command STS 82, with Scott ('Doc') Horowitz as pilot. The Payload Commander was Mark Lee, with Mission Specialists Greg Harbaugh, Steve Hawley, Steve Smith and Joe Tanner. All the crew had extensive spaceflight experience; Steve Hawley had been on the original HST deployment flight in April 1990, and Ken Bowersox had been the pilot on the first HST Servicing Mission. Greg Harbaugh had also served as a backup to the STS 61 crew if any of them were unable to make the flight as well Mark Lee had also supported operations for STS 61.

The spacewalkers for the flight were Mark Lee (EV1), Steve Smith (EV2), Greg Harbaugh (EV3) and Joe Tanner (EV4). If any emergency spacewalks were to take place, Lee and Smith would undertake them.

Training for STS 82 began in July 1995 at the Johnson Space Centre in Houston, Texas. Among the training facilities used for the flight included the Weightless Environment Training Facility (WET-F), which is a swimming pool that provides a similar environment to working in zero gravity. Virtual reality training was also used, as was the

Astronaut Steven Hawley controls the shuttle's remote manipulator arm from the aft flight deck, during one of the EVAs. He spent many hours doing so. Hawley also flew on the 1990 mission which originally deployed the HST.

Hubble gets an improved outlook

Precision Air Bearing Room at JSC — which allows instrument mockups to float on a cushion of air to simulate the mass handling of large objects in the space environment.

February launching

Following the completion of a Flight Readiness Review, the STS 82 launch was set for 11 February 1997. After a trouble free countdown, *Discovery* was launched from Pad 39A at the Kennedy Space Center in Florida at 3:55am (local time). It was *Discovery*'s first flight since July 1995, as it had been undergoing a maintenance overhaul.

Discovery's initial rendezvous burn for the HST was when the space shuttle was launched. The launch was timed to occur during a one-hour period as the telescope passed within the desired range of the space shuttle. After the launch, the crew oversaw a series of orbital adjustment burns to catch up and retrieve the telescope, which was in a 582km altitude on flight day 3.

Once *Discovery* was safely in orbit, the payload bay doors were opened and the Ku-band antenna was activated. This antenna is used to provide radar data to the crew and ground controllers during the rendezvous process. Steve Hawley also activated the Remote Manipulator System (RMS) arm to ensure that it was in working order for the capture of the HST. The crewmembers who were making the spacewalks also checked out their spacesuits thoroughly.

Another procedure was to lower the cabin pressure from 101.3 kilopascals to 70.3kPa, which helped the spacewalkers to maintain the higher level of oxygen in their bloodstream to safely operate in the lower pressure of their spacesuits. At the same time, HST ground controllers shut down the telescope's systems, in preparation for its servicing.

Two hours prior to the capture of the HST, Ken Bowersox and Doc Horowitz performed a terminal initiation burn as *Discovery* came within 12km of the telescope. Ken Bowersox then took manual control of the shuttle at a distance of 730 metres below the HST. The approach from underneath the HST ensured that any potential contamination from *Discovery*'s thrusters did not contaminate the HST's scientific instruments.

Once *Discovery* got to within 12 metres of the HST, Steve Hawley grappled the telescope with the RMS arm and successfully placed it onto the Flight Support Structure in the payload bay. Ken Bowersox then radioed ground controllers that "Dr Stevie just shook hands with an old friend". Once the HST was secure, ground controllers began a comprehensive photographic survey to look for any major damage caused by its seven years in space.

The first spacewalk was delayed to enable ground controllers to assess the movement of one of HST's solar arrays, which had slewed from a horizontal to a vertical position as *Discovery*'s airlock was pressurised. The motion was caused by an apparent gust of air from the airlock, but caused no damage to the array which was later repositioned vertically.

Once the spacewalk commenced, Steve Smith who was attached to the end of the RMS arm and Mark Lee who was tethered to the shuttle, opened the aft shroud doors and removed the Goddard High Resolution Spectrograph and Faint Object Spectrograph from their compartments, replacing them with the Space Telescope Imaging System and the Near-Infrared Camera and Multi Object Spectrometer. Once the new instruments were installed, ground controllers performed health checks — pronouncing the new instruments to be alive and well.

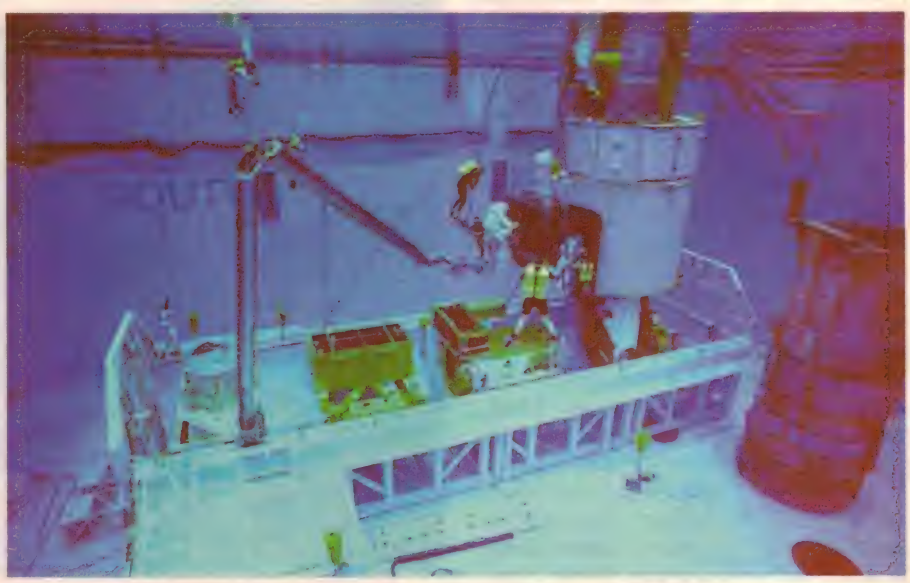
The old instruments were stored in special containers for the trip back to Earth, then Lee and Smith returned inside after a spacewalk of six hours and 42 minutes. During the spacewalk, Mark Lee took time out to wish his wife (and fellow astronaut) Jan Davis a Happy Valentine's Day!

The following day Greg Harbaugh and Joe Tanner ventured outside for a seven hour 27 minute spacewalk, to replace and install several new engineering components. Their first task was to replace a Fine Guidance Sensor. The astronauts also installed the Optical Control Electronics Enhancement Kit, which increases the capabilities of the FGS. It was during this spacewalk that the astronauts noted that HST had undergone some wear and tear, with cracked thermal insulation and dozens of holes in the skin of the telescope.

Even though Hubble is covered with 20 layers of thermal blankets, it was eventually decided that a fifth spacewalk would be required to do a patch job.

During the third spacewalk, Lee and Smith removed and replaced a Data Interface Unit which provides command and data interfaces between Hubble's management and other subsystems. They also installed the new Solid State Recorder as well as changing one of the Reaction Control Wheels. Near the end of the spacewalk, Bowersox and Horowitz gently fired *Discovery*'s thrusters to boost the HST into a higher orbit — its orbit had deteriorated by 10 kilometres since December 1993.

Following the completion of the fourth spacewalk by Harbaugh and Tanner, the replacement and installation of all the science and engineering com-



During the many months of training for the STS-82 mission, crew members practiced Hubble upgrade EVA procedures in the huge water tank of the Neutral Buoyancy Laboratory at the Sonny Carter Training Center Facility.

ponents for HST was complete. The first task of the six hour 34 minute fifth spacewalk was to replace a Solar Array Drive Electronics package which is used to control the positioning of the solar arrays. Next, the two astronauts ventured to the top of the telescope where they placed new covers over the magnetometers, replacing the makeshift ones that had been fitted by the STS 61 crew.

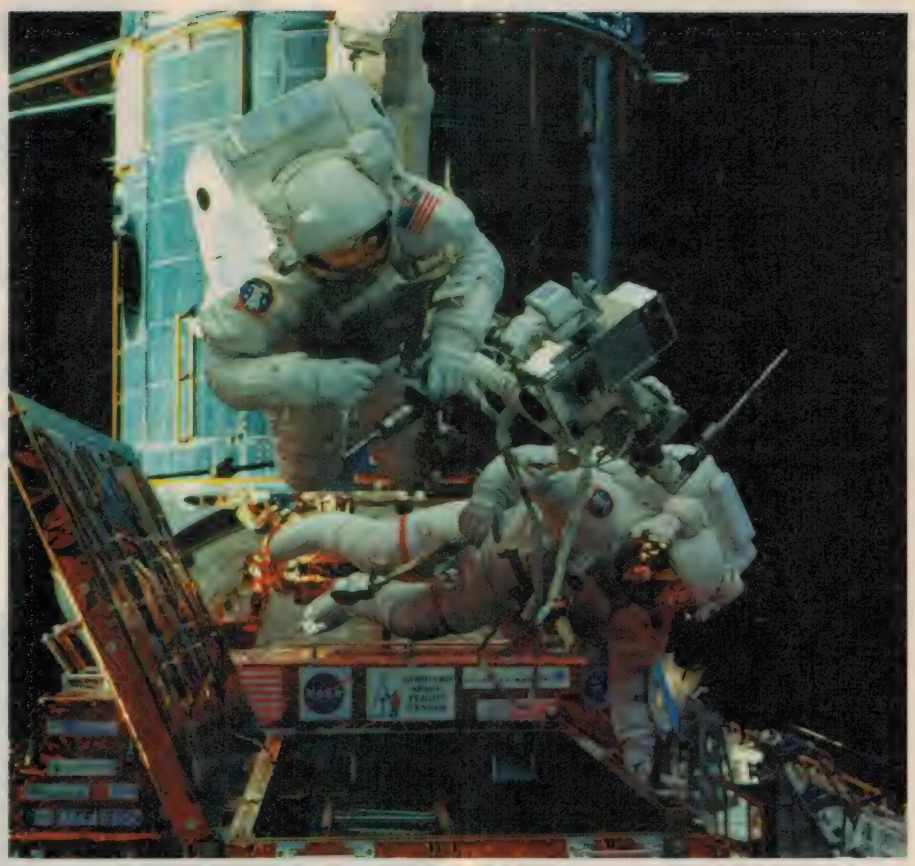
Whilst Harbaugh and Tanner were outside, inside the crew cabin Scott Horowitz and Mark Lee were busy fabricating additional thermal insulation blankets that would be installed on the fifth and final spacewalk. During this five hour 17 minute spacewalk Lee and Smith attached several thermal blankets to three equipment compartments at the top of the HST's Support Systems Module which contains key data processing, electronics and scientific instrument telemetry packages. Once that was completed, Lee and Smith briefly returned to the airlock whilst ground controllers analysed a glitch in one of the four Reaction Wheel Assemblies. However no further action was needed, so Lee and Smith completed their spacewalk by packing everything up and returning to the crew cabin.

After the five successful spacewalks, Steeve Hawley again used the RMS to deploy the Hubble Space Telescope into its original 1990 altitude of a 590km-high orbit. Hawley's parting comment was that "HST is free to study the stars".

After the HST was deployed, Bowersox and Horowitz fired jet thrusters to begin the shuttle's separation from the telescope. Should anything have gone wrong with the Hubble then, the crew would not have enough fuel to return to it.

Soon after Hubble's deployment, ground controllers reported that the HST had resumed standard operations and was processing commands from the ground through the TDRS system. Over the next couple of months, calibrations of the new scientific instruments were taking place and the first images were expected to be publicly released by June.

Following the deployment of the HST, the crew had a day off. The following day they began to pack up their tools and prepare for the trip home. Bowersox and Horowitz began the day by verifying the *Discovery*'s aerodynamic surfaces — the elevons, speed brake and rudder. The usual test of the steering jets was not required, since 31 of the 38 jets had been fired during the rendezvous and redeployment activities with the HST. The remaining jets were to be fired during the deorbit activities. Also held was the traditional in-orbit press conference, along with a congratulatory call from NASA Administrator Dan Goldin.



Astronauts Steven Smith (left) and Mark Lee equip themselves with the tools needed for one of the Hubble upgrade sessions, from Discovery's cargo hold. This shot was taken with a 70mm camera from inside the shuttle's cabin, during one of the EVAs.

Although there was a chance of showers at the Kennedy Space Centre, they did not eventuate and *Discovery* landed there at 1:32 am (local time) on 21 February 1997. Additional illumination for the landing was provided by the installation of 52 halogen lights, which were positioned every 60 metres down the runway.

Next service: 1999

Planning has already begun for the next Hubble Servicing Mission, which will take place in 1999. There will be new scientific instruments installed, as well as a pair of rigid solar arrays to replace the current ones, which are still giving ground controllers minor problems.

One new scientific instrument that is planned is the Advanced Cameras for Surveys (ACS), which will enhance the HST's imaging capabilities. ACS is an advanced camera that will have a predicted performance improvement of one to two orders of magnitude over the existing Hubble science instruments. Periodic upgrades will take place every three years and there is now talk of a replacement telescope known as 'The Next Generation Space Telescope'.

However until that time comes, the Hubble Space Telescope will continue to amaze us and expand our knowledge of the Universe even further. It will also continue to ensure that astronomical texts are obsolete the minute that they are published!

By the way for a superb chronicle of HST images, I highly recommend the book *Hubble Visions* by Caroline Petersen and John Brandt. Another recent release, *Gems of Hubble* by Jacqueline Mitton and Steve Maran, is an excellent introduction to HST. Both books are available through Cambridge University Press.

Finally I wish to thank Colin Burgess and Debbie Dodds of the Johnson Space Centre; and Jim Elliott, Louis Kourtidis and John Wood of the Goddard Space Flight Center for their assistance in the completion of this article. All photographs are courtesy of NASA and Ball Aerospace. ❖

New research findings on cellphones & health:

THE REPORT YOU WEREN'T SUPPOSED TO READ ABOUT

In late April, the results of an extremely important Australian research study into the biological effects of radiation from digital cellular phones were released. The study's findings have aroused great interest around the world — but were hardly reported in Australia's own news media. Here's a rundown on what the study found and why it's so important, plus some insight into the way it's been quietly swept under the media carpet...

by STEWART FIST

Many years back, before my conscience began to bother me, I spent a few years as a public relations consultant with the world's second largest PR company. In the process, I learned how easy it is to manipulate the media — we did it on a daily basis.

One whole sub-section of public relations is devoted to what they now call Crisis or Risk Management. And, in America, if your company faces substantial health or environmental problems, you can hire specialist crisis-management corporations with a 'scientific-research' front, which often promote themselves as 'Risk Analysts'. These people will take over the scientific tasks of independently proving your product/service to be safe, and they usually save a lot of time and avoid confusion by writing the research conclusions first.

To a very large degree, research into the safety of cellular phones in most of the world has been conducted in this way for many years. In fact, it has earned the reputation of being 'tobacco science'. There are some truly independent researchers working in the field, on both sides of the debate — but also a lot of charlatans and fundamentalists. There are also activists and their scientific supporters, who oppose cell phones (in particular towers), in a sort-of aesthetics-health-environment-religious way.

However the ones with the money are PR and mercenary-science companies, and they are now very skilled in ways of defusing issues — mainly by the judicial and selective release of information to selected parts of the media.

Late in April, either deliberately or accidentally, this was done with some very disturbing news about Australian research conducted over four years, into cellular phones and their potential to cause or promote tumours.

Digital cellular phones: they're compact and convenient, and Australians have adopted them with gusto. But does significant use carry a long-term risk of brain tumours? The research findings are starting to suggest so...

Telstra executives were running around in a semi-panic all week, and they hastily organised, with the help of the Royal Adelaide Hospital, a video-conference bringing in Dr Michael Repacholi from Geneva to officially announce the report and explain why it was insignificant.

Journalists who have been keenly awaiting the release, and writing about cell-phone and health issues for a few years, were *not* invited to the video conference. None of the most prominent Australian research scientists working in this area were present, nor were the scientists who conducted the research, or even oncologists from the hospital itself.

Then on the Monday morning (28th April), on the anniversary of the Port Arthur Massacre, details of the report were leaked to the Hobart *Mercury*, two days before the official release. This ploy effectively killed the interest of the national newspapers in the story, so it received scant treatment.

What they found

The full details of this most important piece of research are these.

Four years ago, Telstra agreed to fund a research program to investigate claimed links between cellular phones and cancer. The funding was organised by physicist Dr Michael Repacholi, who has been working through the Australian Radiation Research Laboratories and Royal Adelaide Hospital, and had long been a vocal spokesman for the position that 'cell phones have no real or potential adverse health effects'.

Repacholi involved Professor Tony Basten, Executive Director of the Centenary Institute of Cancer Medicine and Cell Biology at the University of Sydney; Dr Alan Harris, a cancer biologist from the Walter and Eliza Hall Institute of Melbourne; and statistician Val Gebski of the NHMRC. Repacholi then left early in the program, to take up a job with the World Health Organisation in Geneva.

Since the funding had come from Telstra, the scientists insisted that the research protocols should be established and supervised through the independent National Health & Medical Research Council (NHMRC), to ensure that Telstra had no influence over the results. It took nearly six months to formulate acceptable protocols with Telstra and to obtain 200 specially-sensitive transgenic mice. These mice were bred to be highly sensitive to external impacts on the T-cells of their immune system.

The mice were divided into two groups of 100 each, housed in absolutely identical conditions, and subject to the same amount and type of handling. The match extended even to having a sham antenna hanging over the control group.

The only difference was that one group had an active antenna, and the other group had none. Half the mice were subject to GSM-type pulsed microwaves, at a power-density roughly equal to a cell-phone transmitting for two half-hour periods each day.

The experiment was conducted as a blind trial. Dr Harris, who conducted the autopsies, was never made aware of to which group each mouse belonged, in order to ensure that his prejudices couldn't influence results.

Yet over the 18 months, the exposed mice had 2.4-times the tumour rate of the unexposed mice. This was later adjusted down to a more confident 2-times claim to remove some unrelated kidney problems experienced by some of the mice, and correct for other possible influences.

Tumours began to show up at about nine months, and the rate increased steadily for another nine months, until the last mice were killed for autopsy. This seems to suggest that the effects are cumulative and dose-related over time.

This was one of the most carefully controlled and extensive studies of its kind done anywhere in the world, and it has turned up probably the most significant and obvious links between adverse health effects and cellular phones yet.

The team finished their evaluation work in the middle of 1995, and yet the published report of their research in the international journal *Radiation Research* was only released two years later. This was always going to be a political hot-potato.

According to Dr Harris, these findings are very important, and statistician Val Gebski says they are 'highly significant' (well above the 1% significance level). So this research takes a giant step towards answering long-standing questions about the biomedical effects of radio waves.

A new clue to the mechanisms has also been found. The research showed a very significant increase in a form of B-cell lymphoma. The importance of the B-cell (rather than the normal T-cell) here is that B-cell effects are implicated in roughly 85 percent of all cancers. As one promi-

Of mice and men

The Adelaide report follows two other fierce brush-fires in the cell-phone industry. The first was generated last year when Dr Henry Lai and Dr Singh at Washington State University in the USA reported enormous increases in double-strand DNA breaks in rat-brain tissue following microwave exposures of only two hours. The industry has tried to ignore these findings, claiming that the frequencies used were not identical to cell-phones; but this is only one of a series of experiments conducted over many years which show similar findings.

However, few scientists are independently funded like Drs Lai and Singh. Most need to go cap in hand to the Wireless Technology Research (WTR) group in the USA, which is funded by the cell-phone industry through an 'escrow account' (arms-length third-party) run by a very well known opponent of environmental health groups, Dr George Carlo.

Dr Carlo is a very experienced epidemiologist and 'Public Issues Manager' who has worked for companies ranging from those in the nuclear industry with environmental spills and still-birth problems, to dioxins (through the Chlorine Institute), to pesticides, herbicides, Agent Orange, and, more recently, Breast Implants. He owns a large number of research and 'think tank' organisations which act for companies or industries having problems, and he currently runs all 'independent' research on behalf of the Cellular Telephone Industry Association (CTIA).

Recently, as reported in a number of US papers and magazines, the WTR has become embroiled in a number of scandals and questions are currently being asked in the US House of Representatives as to where US$25 million in research funding has been spent, and why there are no results.

The WTR was promoted to the public and to the US Government as being an 'independent' and 'arms-length' body controlling all research funding. But documents leaked to *Microwave News* and *Radio Communications Report* (RCR) show that it has been under the direct control of the industry association (CTIA). It has long operated as a PR front and provider of funding to controlled research — often carefully designed to guarantee nil results. In the last four years it has spent US$17 million "without wetting a test-tube", according to *Microwave News* editor Louis Slessin.

Radio Communications Report (March 3 1997) claimed that following the tobacco industry's problems, WTR scientists went on strike for nearly a year, refusing to perform their contracted work until they were adequately covered for indemnity against law suits. Last week, the CTIA finally paid up US$938,000 to fund coverage.

As one other prominent American scientist explained to me in an e-mail:

I am also puzzled by the WTR process. I simply don't know what they mean by "indemnifying scientists against law suits". Why would they anticipate any problem? Thousands of scientists in the US are doing research without 'law-suit' insurance.

RCR has done a good job in reporting the conditions of RF research and industry involvement in the US. Other countries in the world, such as EU and Australia, are gearing up to do research and we are basically grounded here in the US.

It is a shame. Motorola is now the only source for funding of on-going research. But they hand-pick their investigators without going through the usual peer review process and have tight control of their researchers on what they can say and report.

The WTR scientists' sensitivity to this issue follows the filing of 38 cases which are now before the courts over past tobacco-safety studies. Both the tobacco company lawyers and the scientists they funded have been charged as co-conspirators with the Tobacco Institute and the cigarette companies, in suppressing evidence and manipulating research results.

nent biomedical researcher explained:

B-cells are very important in immune responses. They produce antibodies against bacteria, foreign substances, etc, and also [provide] surveillance against the appearance of cancer cells in the body. One would be more prone to infection if these cells are affected, as in the case of B-cell lymphomas.

In a carefully worded statement to the press, Professor Basten suggested that the correlation between animal studies and humans is complex, and that "more focused research needs to be done to resolve that issue".

This is a common fire-extinguishing approach, with the idea of hosing-down media sensationalism. The 'Men aren't Rodents' claim is both obviously correct, while at the same time discounting 150 years of medical and pharmaceutical research. Our recent Nobel Prize winner, Professor Peter Doherty, was awarded it for his work in the immune system using mice.

As one of the other Adelaide scientists pointed out, they were not researching mice, they were looking for DNA changes in cells. At the level of disruption of normal cell-growth processes (which are fundamental to cancers), animal and human cells act pretty much alike.

Another popular claim is that the study used specially bred transgenic mice, genetically modified to be susceptible to tumours. This confuses 'susceptibility' with 'sensitivity' — the system noise, with the signal.

Mice have a life span of only two years, so it's hard to test the effects of 50 or 80 years of cell-phone exposure on rodents unless the incubation period is shorted. Brain cancers, for instance, take about 10 years to reveal themselves in humans.

The mice are simply detectors — and the more sensitive the detector, the better. These were 'low-susceptible' mice, injected with a gene which made them sensitive to assaults on their DNA — and most cancers arise from changes at this cell level.

It is also a common mistake to criticise this research for what it *doesn't* prove, rather than what it *does*. It set out to establish whether non-ionising radiation CAN have a direct effect on cells at the DNA level — and CAN either cause cancer, or promote it. That's all.

But that's more than enough, because this possibility has been vigorously denied by the radio industry for close on a century.

It is not the absolute numbers of tumours that are at issue here; it is a highly-significant doubling of tumour rates in the exposed group. I don't remember any research of a similar sort in the past few years that has shown increases of this order.

The increased rate of tumour growth began at about nine months, and continued to the end of the research. This graph was continuing to rise, which suggests that the effects of exposure are cumulative over time.

We aren't dealing with a crisis like an air-crash; our concern must be with the use of cell-phones over a lifetime. Teenagers now have their own cell-phones, so they could be exposed for 80 years or more.

And we aren't dealing with any certainty of disease; obviously some people (like some mice) are specially susceptible, while others never need worry. But it would be nice to know how to distinguish these two groups.

Critics are also commenting on the size of the mice, because of its relationship to the wavelength. But this assumes the old theory — now soundly discredited — that the only adverse effect of non-ionising radiation exposure is localised heating (or full body heating in the mice). Heating requires absorption, and in tissue this occurs most at resonant frequencies.

But although the brain and body are reasonably good electrical conductors, they are by no means *simple* electrical devices. Scientists are now detecting layered-resonance effects (basically capacitance in body tissue) and stochastic resonance (the eye and the brain seem to be able to operate under threshold power levels using system noise amplification), so none of these old full-body resonant claims make sense any more.

Mice are roughly about the size of a full wave at cell-phone frequencies — and the human head (transversely) is a couple of times the wavelength of PCS. Mice also wander around, sometimes facing the source, sometimes side on. Brains are of variable size (the foolishness of this controversy makes this obvious!), and eyes are of another size, as are ears. Who can say which animal-part would be closer to the resonant frequency for any cell phone emission?

And does it matter anyway? The whole point of this experiment was to establish beyond doubt that non-thermal molecular-cell effects occurred through exposure to radio waves. The level of exposure used here would not raise body temperature by a fraction of a percent of 1° Celsius (less than 10 seconds in the sun) — yet the cancer rate doubled.

Yet this is the basis for all radio exposure standards. The danger point was assumed to be exposures that raised tissue temperatures by 1°C — now we know that it is unrelated to temperature.

How trustworthy?

What makes this study especially significant is that the honesty and validity of both the procedures and the scientists are beyond dispute. If your inclination in such matters is towards corporate conspiracy theories, it must be pointed out that the findings were in no way advantageous to Telstra. There can be no question that they influenced the research in any way once the protocols were in place.

However Telstra did have a confidentiality clause inserted in the contract which prevented the scientists from revealing their findings for a number of years. I find this most disturbing, since both the scientists and Telstra are publicly funded.

Also, under the terms of their contract, Telstra had a three month preview of the report before publication in which to train and activate its fire-fighters — and it turned them out in force. In fact, hosing down the results probably cost Telstra more than establishing them.

Vodafone stole some of the thunder from Telstra by pre-announcing the findings of the Adelaide research six months ago. They published a booklet quoting the Adelaide Research as finding 'there is no substantial research which indicates the level of emissions from mobile phone base stations could lead to adverse health effects' — without mentioning handsets.

This mouse exposure was *pulsed* transmission as from a GSM (digital) handset (i.e., matched power densities), not the *steady* transmission of a cell-phone *tower* — and most of us (but few of the public) have heard about the Inverse Square Law.

The American CTIA (Cellular Telephone Industry Association) followed this line of public confusion in an 'advisory' to their members on how to counter press questions. They suggested the statement: 'The mice were exposed to radiation that was more than 1000 times higher than average exposure in the service area covered by a typical cell site'.

More to the point would have been an objection based on GSM's pulsed nature. The Americans still remain staunchly in the AMPS analog camp, with very little intrusion of time-division digital phones. But GSM in Australia is on a rapid rise, because AMPS is being forced out — and GSM pulses its power in a stroboscopic

fashion, at 217 times a second.

Many scientists believe it is the 217Hz low frequency component of the signal that is the problem — in fact, one study about to be released in America suggests analog RF may be a tumour inhibitor. So some beneficial knowledge may come out of all this yet.

The conduct of the Adelaide experiment actually also raises questions more about the potential for cell-phone handset radiation to effect people nearby (passive exposures) than just the user him/herself. The experiment was conducted in the 'far field', at distances of about 36cm, which is greater from the mice than the cell-phone is normally held from the head. They obviously had troubles strapping cell-phones onto the mice heads, so had to make do with a more general exposure...

Near-field biological effects in EMF effects are thought to be substantially different from far-field, although the biomedical implications are not clear. Also, in close proximity, most of the energy transfers from the handset to the head by induction rather than just radiation, and this can actually raise the energy transfer by a factor of four.

The study therefore under-rates the potential power effects on the handset user from the ELF component, while possibly over-rating those from RF for people nearby.

But this is par for the course. No single study is ever definitive, and every experimental design, other than concentration camps and human autopsies, raises questions of methodology and relevance.

There's been evidence accumulating over many years that the long-term effects of radio frequency exposures may have serious consequences for a small percent of the population, but this has been ignored by the industry and by governments alike.

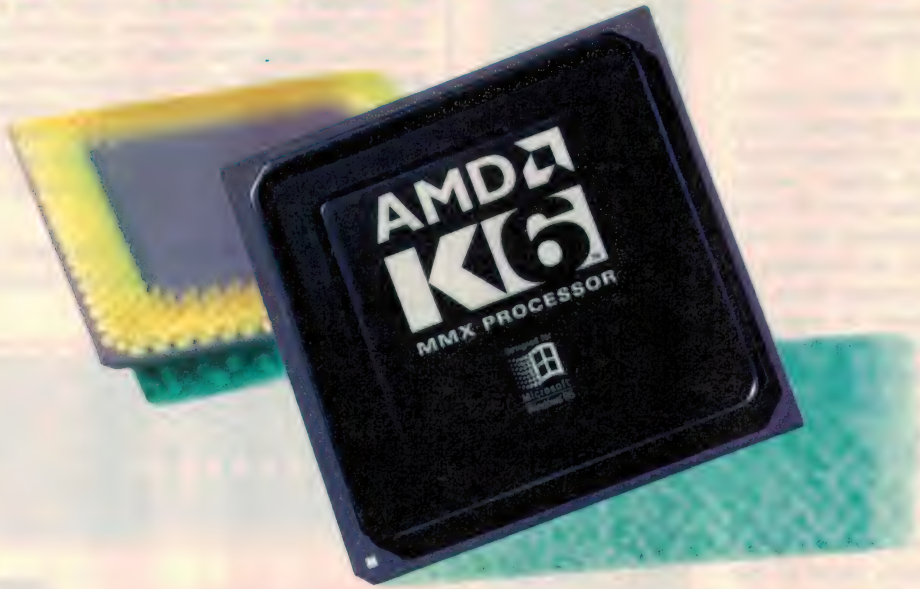
So nothing done in the last few years has more obviously established that cell-phone *safety* has not yet been proved — or so clearly, that the standard-setting process is wrong — than the Adelaide research.

Prof. Tony Basten concluded his release with the statement "For the time being, at least, I see no scientific reason to stop using my own mobile phone". But this is largely irrelevant. At his age and in his occupation, the potential dangers from increased phone use are probably minimal.

The question is, would he buy his teenage child one?

The common sense approach at present is surely 'prudent avoidance'. ❖

AMD SURGES BACK



WITH ITS K6 CHIP

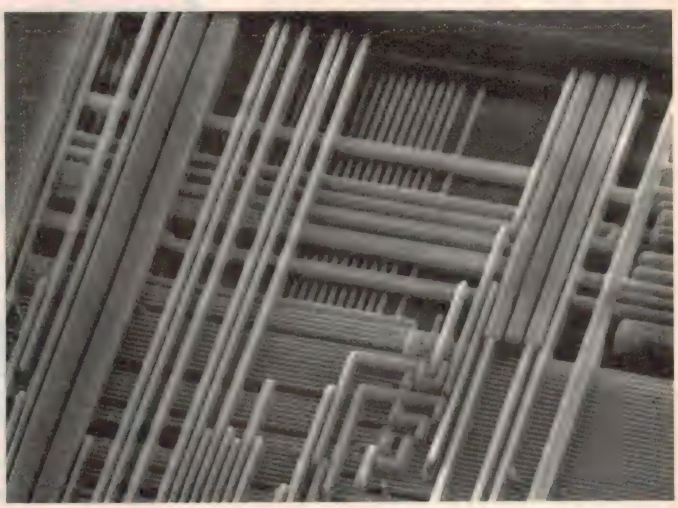
A couple of months ago, Advanced Micro Devices released its new K6 microprocessor chips — now shaping up as the first serious competitor for industry giant Intel's own new Pentium II family. From a rocky period a couple of years back the company now looks set for a period of rapid growth, and that's certainly the impression EA's editor Jim Rowe gained during a recent visit to the AMD headquarters in Sunnyvale, California. He also learned some of the background to the development of the K6, and met some of the people responsible...

by JIM ROWE

Even before AMD's K6 microprocessors were officially released on April 2 this year, the new chips had won praise from reviewers and industry analysts around the world. Comments like "world's fastest X86 chip" (Linley Gwennap, *Microprocessor Report*), "In side-by-side comparisons, it equalled and even bested equivalent Intel machines on our Winstone benchmark" (Bill Machrone, *PC Week*) and "AMD is poised to become the most significant alternate to Intel in 1997" (Michael Slater, *Microprocessor Report*) were the order of the day — quite a change from a couple of years ago, when many analysts had all but consigned AMD to corporate oblivion following its troubles with the earlier K5 processor.

The fact is that over its 28-year history AMD has weathered a number of storms, and always surged back. All the signs seem to be that the company is set to repeat this trick yet again, and quite possibly give microprocessor giant Intel the biggest 'run for its money' that anyone has achieved yet.

What's the secret of AMD's resilience? Undoubtedly much of it stems from the Company's fiesty CEO and Chairman of the Board, W.J. ('Jerry') Sanders III. Mr Sanders was one of the eight cofounders of AMD



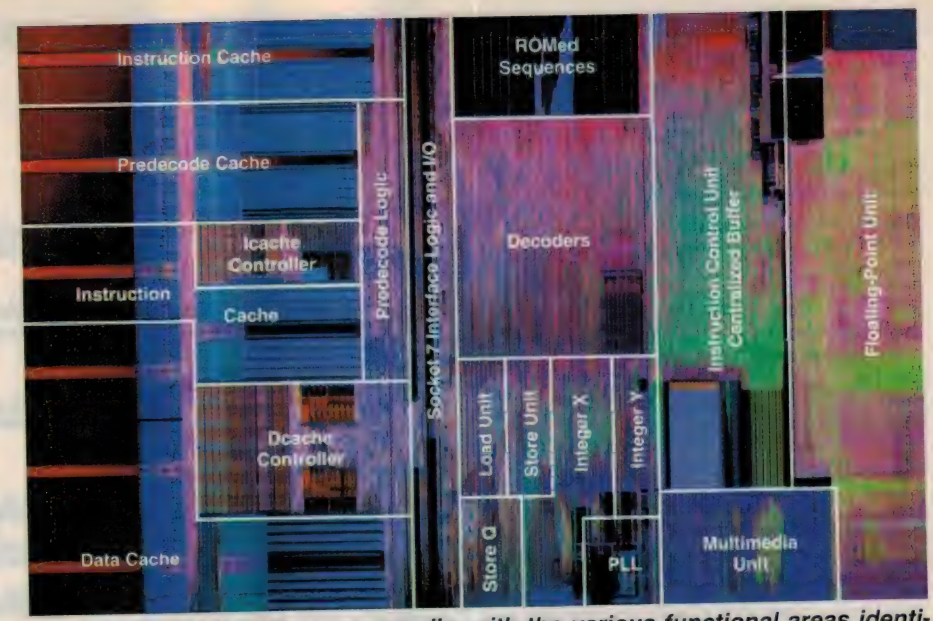
A scanning electron microscope photo of a small area (about 70um wide) on the top of a K6 processor chip, with the passivation etched away to show some of the five layers of metallisation.

back in 1969, and has been the Company's CEO for much of its history. He has a reputation for enjoying the challenge of overcoming corporate setbacks, and AMD has certainly struck a few of those along the track.

Mr Sanders also has a reputation for finding the right people for his company, and being able to motivate them to succeed. AMD has featured regularly in *The 100 Best Companies to Work For in America*, and is widely acknowledged for treating its employees well. And that above all seems to have been AMD's secret in achieving its latest coup with the K6 — collecting together the right people, providing them with the resources to succeed, and encouraging them to do so.

Critical acquisition

In many ways a crucial step also seems to have been AMD's acquisition of NextGen Inc., which was completed in early 1996. As part of the deal AMD not only acquired NextGen's leading-edge Nx686 processor design (which became the K6), but also and more importantly both NextGen's dynamic founder and CEO Atiq Raza (now AMD's Senior VP and Chief Technical Officer), and its hot-shot processor designer Vinod Dham. Mr Dham is famous in the semiconductor industry as the former VP of Intel's Microprocessor Products Group, where he was responsible for the development of the 386 and 486 processors and was also chief architect of the early Pentiums. He was also co-inventor of Intel's flash memory technology.

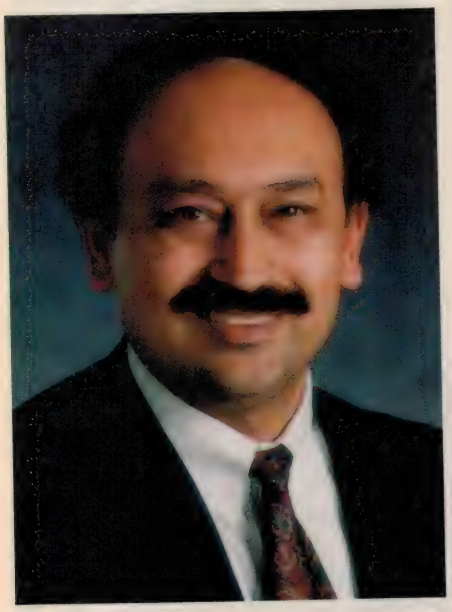


An overview of the K6 processor die, with the various functional areas identified. The chip features 32KB of L1 cache and another 32KB of L1 instruction cache — twice the size of those on the Pentium II.

During a recent tour of Silicon Valley as part of an Asian press briefing tour, I was fortunate enough to visit AMD and be present at presentations by a number of its key executives, including Atiq Raza and Vinod Dham. Both gentlemen were most impressive — Mr Raza for the breadth and clarity of his insights into the future of computing and communications technology, and Mr Dham for the depth of his understanding of microprocessor architecture and fabrication technology.

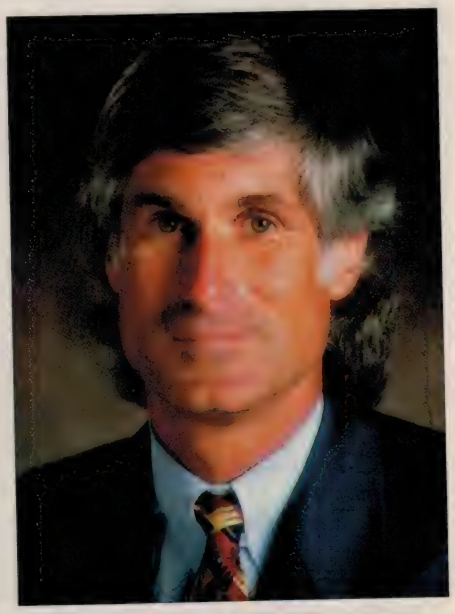
We were also lucky enough to get a tour of AMD's Submicron Development Center (SDC) and a briefing from Jim Doran, VP of Technical Operations at the SDC. Mr Doran gave us an overview of the Company's work in chip fabrication technology, and the progress it's making in getting new submicron fab plants up and running. It became very clear that AMD is putting a huge amount of effort — and a significant cash investment — into building an array of leading-edge chipmaking plants.

At this stage the Company's product design and process technology devel-



Atiq Raza, now AMD's senior VP and Chief Technical Oficer, who was previously NextGen's founder and CEO.

Vinod Dham, Group VP and chief K6 designer, who was chief architect of Intel's early Pentium processors.

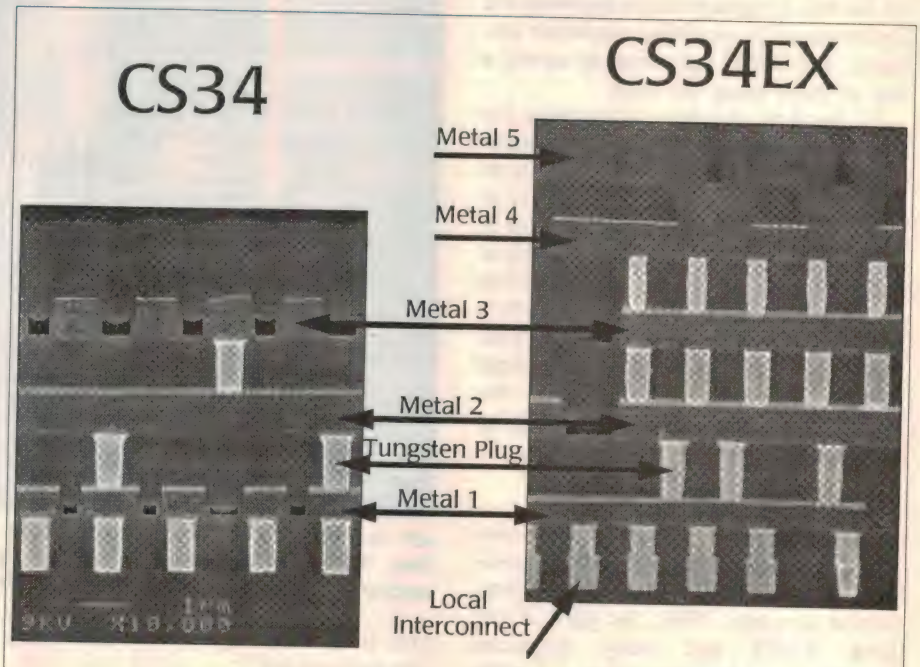


Jim Doran, production expert and VP of Technical Operations at AMD's Submicron Development Center (SDC).

opment are carried out at the SDC in Sunnyvale, a world-class facility with a capacity of 2000 six-inch wafers per week. High-volume manufacturing is carried out at AMD's Fabs 10, 14, 15 and 25 (a US$1.4 billion 0.35-micron microprocessor and logic facility) in Austin, Texas, and also the joint venture flash memory fab of Fujitsu AMD Semiconductor Ltd (FASL) in Aizu-Wakamatsu, Japan. The Fab 25 facility in Austin has a capacity of 6250 eight-inch wafers per week, while the FASL facility has a weekly capacity of over 5000 eight-inch wafers.

Construction is now also under way on a new state of the art Fab 30 facility in Dresden, Germany — AMD's first European fab plant. Involving an investment of US$1.9 billion, the plant will have a weekly capacity of 6000 eight-inch wafers and is expected to be used to manufacture AMD's next-generation K7 processors, using 0.18um technology. A second flash memory fab plant is also being built at the FASL facility in Japan, involving a further investment of US$1.2 billion.

The Company's device assembly and test operations are carried out in Penang, Malaysia, Bangkok in Thailand, and in Singapore. An additional assembly and test facility is under construction in Suzhou, China.



Electron microscope views comparing the three layers of interconnect metal in the K5 chip's CS34 process (L) with the five-layer CS34EX process used in the new K6 processor. Note the flatness and uniformity of the layers.

All told, AMD currently has around 12,000 employees world wide, and an annual sales turnover of more than US$2 billion. With the investments it's making in fab plants and the development of leading-edge technology, the Company does indeed look set to play a leading role in the much-heralded convergence of computing and communications technology.

Table 1: AMD-K6™ MMX Processor — Technical Features Comparison

Processor Features	AMD-K6	Pentium Pro	*Pentium II	Pentium w/ MMX (P55C)
Superscalar architecture	Yes	Yes	Yes	Yes
High-performance RISC core	Yes / 6-issue (RISC86®)	Yes / 5-issue	Yes / 5-issue	No
• Speculative execution	Yes	Yes	Yes	No
• Out-of-order execution	Yes	Yes	Yes	No
• Data forwarding	Yes	Yes	Yes	No
• Register renaming	Yes	Yes	Yes	No
x86 decoders	2 sophisticated 1 long, 1 vector	1 sophisticated 2 simple	1 sophisticated 2 simple	1 sophisticated 1 simple
Execution units	7	5	5	3
Branch prediction	Yes	Yes	Yes	Yes
• Advanced 2-level branch prediction	Yes	Yes	Yes	No
• Branch history table entries	8,192	512	512	256
• Branch target cache entries	16	0	0	0
• Branch prediction accuracy	95%	90%	90%	75-85%
MMX	Yes	No	Yes	Yes
High-performance floating poin	Yes	Yes	Yes	Yes
L1 instruction and data cache	32K + 32K	8K + 8K	16K + 16K	16K + 16K
Industry-compatible SMM	Yes	Yes	Yes	Yes
Processor bus	Socket 7 66 MHz	Pentium Pro 66 MHz	Pentium Pro 66 MHz	Socket 7 66 MHz
• Bus width	64-bit	64-bit	64-bit	64-bit
• Max. bandwidth (mb/sec)	528	528	528	528
• Latency (smaller is better)	2 clock	5-7 clock	5-7 clock	2 clock

* Data shown are estimates based on industry publications and derived from reports that Pentium II is based on Pentium Pro. Pentium II is not yet publicly available; final product features may vary from the estimates shown.

(Note that the Pentium II's SEC cartridge does include 512KB of L2 cache memory.)

Inside the K6

But what does this all mean in terms of the Company's current flagship product, the new K6 microprocessor? What are the new chip's key features, and what makes AMD so confident that it will at last enable the Company to capture a significant slice of the Windows-based PC market, from industry giant Intel?

For a start, the K6 incorporates an advanced RISC86 superscalar microarchitecture, claimed to be superior to Intel's Pentium Pro. It also incorporates what are currently the industry's largest level-one (L1) on-chip cache (32KB of data cache, plus another 32KB of instruction cache with precode data) — four times that in the Pentium Pro, and twice that in the Pentium II. See Table 1 for more details.

The K6 chip has delivered excellent results in Winstone 97 tests based on 'performance' PCs using the 32-bit Windows NT operating system, with the 166MHz version outclassing the Pentium 166MHz with MMX, and the 200MHz K6 matching the 200MHz Pentium Pro. At the same time, the K6 also features a high performance

implementation of the industry-standard multimedia extensions (MMX) instruction set, making it highly competitive with the new Pentium II in multimedia applications based on the 16-bit Windows 95 operating system. The 200MHz K6 streaked ahead of the Pentium 200MHz with MMX on a 'performance' PC, for example, in the same Winstone 97 tests. (See Table 2 for comparison details.)

In short, the K6 looks to have excellent performance characteristics using both 16-bit and 32-bit software — whereas Intel's current processors seem to be good at one or the other, but not both.

There are at present three speed versions of the K6, rated at 166MHz, 200MHz and 233MHz. All versions have over 8.8 million transistors, on a chip measuring only 166mm^2. These initial versions are all based on 0.35um process technology. Later this year AMD expects to begin producing chips using 0.25um technology, which will shrink the die size significantly and also provide a further speedup — probably to 300MHz.

Table 2: Winstone 97 Benchmark Comparison

Performance PC: Winstone 97 under Windows NT 4.0				
Processor	AMD-K6-233	AMD-K6-200	Pentium Pro-200	Pentium-200 w/ MMX
Score	72.2	68.7	69.9	66.0
Performance PC: Winstone 97 under Windows 95				
Processor	AMD-K6-233	AMD-K6-200	Pentium Pro-200	Pentium-200 w/ MMX
Score	53.8	51.6	49.2	49.5
Mainstream PC: Winstone 97 under Windows NT 4.0				
Processor	AMD-K6-233	AMD-K6-200	Pentium Pro-200	Pentium-200 w/ MMX
Score	58.2	55.8	56.1	54.0
Mainstream PC: Winstone 97 under Windows 95				
Processor	AMD-K6-233	AMD-K6-200	Pentium Pro-200	Pentium-200 w/ MMX
Score	46.4	44.4	41.8	42.4

Five metal layers

Part of the secret of the K6 chip's speedy performance and compact die size is AMD's mastery of the technology of using no less than *five* layers of metallisation on the top of the silicon chip, to perform a huge number of on-chip interconnections. This is leading-edge technology, and AMD process engineers like Jim Doran are justly proud of the way they've conquered the problems. In his presentation he showed chip cross-sectional views made via scanning electron microscope, and pointed out how planar (flat) were the various levels of metallisation — showing their degree of control.

For the K6, AMD engineers have also used C4 'flip chip' or 'solder bump' technology for making the off-chip connections. This saves a significant amount of chip 'real estate', by avoiding the conventional need for large bonding pads around the edges of the die. Because the small solder bumps used to make off-chip connections can be located all over the chip surface, they can also be located much closer to the processor subsection concerned — improviding chip performance by reducing delays and parasitics.

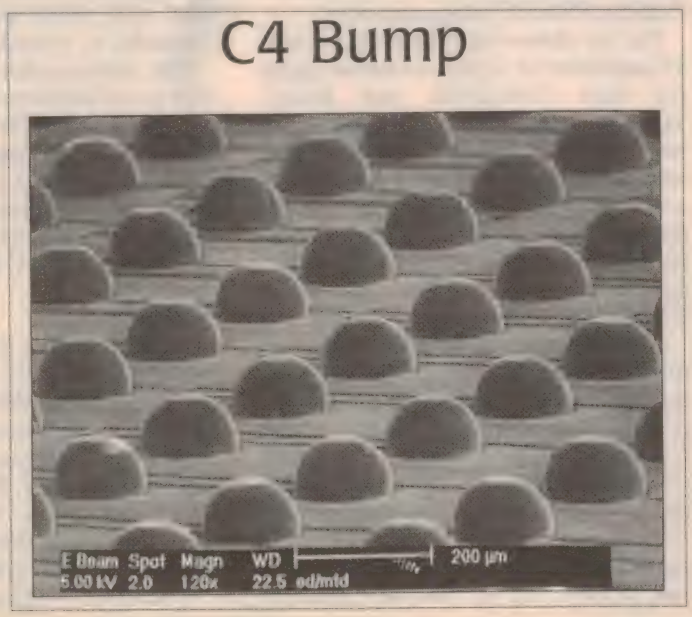
After the array of solder bumps is formed on the surface, the die is flipped over and placed on a ceramic package which has a matching array of metallurgical contact pads. The assembly is then baked in a furnace at 350°C to melt and collapse the solder joints, forming a precise and reliable interconnection. (C4 stands for 'controlled collapse chip connection'.)

Incidentally a further advantage of the small K6 chip size made possible by the five-layer metallisation and C4 flip-chip technology is that AMD has been able to package the K6 in a standard 321-pin ceramic pin grid array (PGA) package, which is fully compatible with the 'Socket 7' provided on all recent generations of PC mother board. This is in contrast with Intel's new Pentium II chip, which is packaged in a completely new vertically-mounting SEC (single edge contact) cartridge requiring a matching motherboard socket.

AMD is confident that quite apart from the K6's impressive performance advantages over the latest Intel offerings, this compatibility advantage will give its new processor an excellent edge in the looming next round of microprocessor wars. Especially as they're apparently able to offer the chips at significantly lower prices than the comparable Intel models...

Having been able to visit AMD's Sunnyvale facilities and meet some of the key people concerned with developing and making the K6, I won't be at all surprised if this product does turn out to be their much-needed winner. And at the very least, the fact that AMD is making such a strong play for a bigger slice of the Intel-dominated microprocessor market is bound to push prices down — so that we end-users are likely to benefit as well.

It should be very interesting to see what happens in the next six months or so. ❖



Another scanning electron microscope image, this time showing the solder bumps formed on the top of the K6 chip and used for off-chip connections. Note the scale.

THE COUNTERFEIT

Recently we described a rhythm generator project, based on the popular 'BASIC Stamp' microcontroller module. Here's a review by the same author of the Counterfeit, a lower cost controller which uses exactly the same Parallax PBASIC interpreter chip and is therefore fully compatible with the Stamp. In Australia it's even available from the same supplier — MicroZed Computers.

by OWEN BISHOP

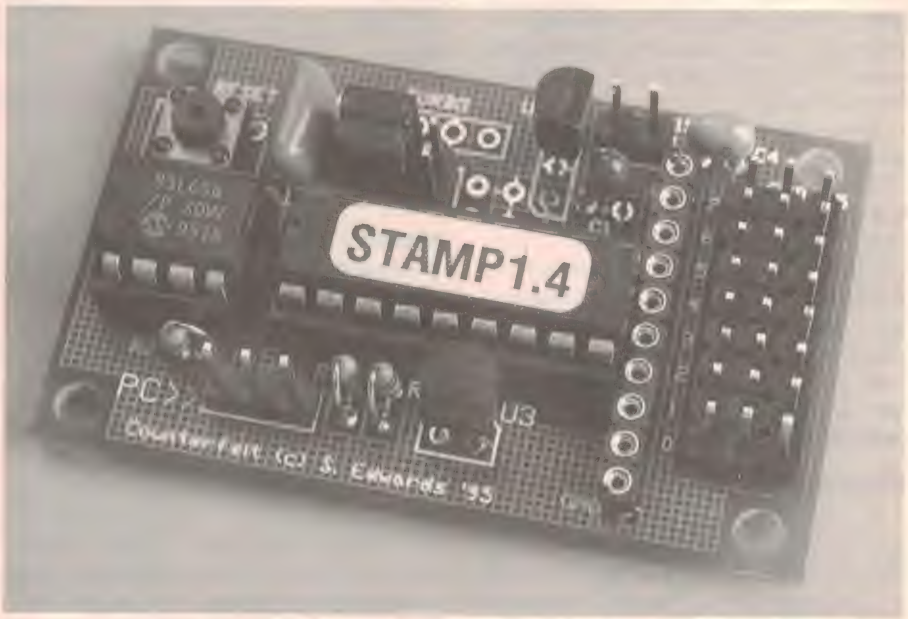
When I ran my computer's Thesaurus on the word 'counterfeit', it came up with false, bogus, phony, spurious, ersatz, fraudulent and numerous other adjectives — mostly pejorative, if not downright rude. Our dictionary is kinder. It says 'made in imitation', and in this case that's closer to the mark.

The Counterfeit is made in imitation of the BASIC Stamp, which is a microcontroller produced by Parallax Inc., of Rocklin, California. The feature which earns the Stamp its name is its small dimensions, for the whole system occupies a postage stamp-sized PCB measuring only 36mm x 11mm. A more worthy feature is that the Stamp understands BASIC, so it is much easier to program than the controllers which are programmed in machine code or assembler. You program the Stamp on your PC, using a special software package and, when it is ready, key Control-R (for Run). In a few seconds the program is downloaded into the Stamp's EEPROM and runs straight away.

If it does not run quite as you intended, it's simply a matter of amending the BASIC program on the PC screen and running it again. When the program is just right, you can disconnect the Stamp from the PC and it retains the program indefinitely. If you switch off power, the Stamp still holds the program and automatically runs it when you switch on again.

This kind of device is invaluable for people who want to build robots and control systems that are too complicated to be put together in hardware alone.

Now we come to the 'fake' Stamp. The Counterfeit doesn't *look* exactly like the Stamp, because it's a little bigger; but it does the same things. Its PCB measures 52mm x 32.5mm, which is still small enough to be handy. The more noticeable difference is that it is built from conventional pin-terminal components, instead of from surface-mount devices like the latest versions of the Stamp. This means that you can build it yourself and, if the worst happens, you can replace the ICs and carry out other repairs.



A closeup of the Counterfeit module, somewhat larger than real size. There's no prototyping area, but header pins to connect to your own circuitry.

It spite of the name, there is nothing shady or underhand about the Counterfeit. It is simply marketed by a different company, Scott Edwards Electronics of Sierra Vista in Arizona, and as it happens, it uses the genuine Parallax PBASIC interpreter chip.

For this review we were provided with a Counterfeit kit by the Australian agents for both Counterfeit and Stamp, MicroZed Computers of Armidale in NSW. In order to be able to program it when completed, you need the software and connector lead that come with the Stamp, which are all available as separate items. Once you are set up with these you can build and program as many Counterfeits (or Stamps) as you like.

Although the Counterfeit lacks the useful prototyping area provided on the Stamp's carrier board, it has a handy set of connections to the outside world. First there is the 10-pin SIP socket, which connects to the eight input/output pins of the processor along with connections to the +5V line (from the built-in regulator) and the 0V line. The regulator can produce up to 100mA, which is more than the Stamp's regulator.

There are also three eight-way headers lying side by side, one of which provides alternative connections to the input/output pins. The second header has eight pins all connected to the regulated +5V, while the third has all pins connected to ground.

This layout makes it very easy to connect components between the input/output pins and the +5V or 0V rails, which is something we quite often need to do. You can make up a three-socket connector aligned across the three rows of stakes, to connect to any one input/output pin, and to +5V and 0V.

In the kit

The Counterfeit kit includes a good quality fibreglass double-sided lacquered PCB with the layout and orientation of the components clearly printed on it. The components supplied are likewise of top quality. Sockets are supplied for the two ICs, so they will be easy to replace if things should ever go wrong. The headers have gold-plated stakes.

A six-page leaflet is included with the

kit to describe how to assemble and test it. From then on you need the Stamp Manual, which describes the BASIC and a number of applications.

The leaflet has a clearly-drawn diagram of the layout of components and a list telling you what they all are. Components are packed quite closely on the PCB, so you need a soldering iron with a small tip — say 1mm or 2mm, as well as a steady hand. Use a low-wattage iron (15W) to avoid overheating, and a fine (0.7mm diam) cored solder.

Assembly was very easy. All the components fitted exactly in their prescribed places and the Counterfeit was ready for testing in under an hour. Here we liked the idea of the test program already loaded in the EEPROM. This program flashes all eight outputs and all you need is an LED and a series resistor, connected to ground. We tried the test and the circuit worked first time.

Thingamebob pack

Here I digress to mention another kind of goody available from MicroZed. This is a pack of their Thingamebobs, which is an assortment of wires and connectors specially intended for prototyping with Stamp and Counterfeit. The wires are about 160mm long and variously coloured, with a spring socket connector at each end. These fit readily onto the pins of the Counterfeit's headers. The connectors will also grip terminal wires or pins of resistors, capacitors, transistors, and many other types of component so they make it very easy to assemble simple circuits and connect them up to the Counterfeit (or Stamp).

Thingamebobs are not restricted to simple wires. One type consists of a pair of wires with a 25-turn variable resistor connected between them. Another type is a pair of wires ending in an LED with a series resistor. This one we found useful with the test program. The red wire plugged on to one of the input/output pins of the header, while the black one plugged on to the adjacent 0V pin.

Other Thingamebobs (or are they Douvres?) have a sounder, a thermistor or a pushbutton switch. Altogether a great idea for prototyping with the Counterfeit or Stamp.

Turbo feature

The Turbo feature of the Counterfeit is also handy, if you are in a hurry. Normally the processor operates with a 4MHz clock, which is quite fast enough for most things you will want to do. But if this is not fast enough, you can add a higher-frequency resonator or crystal running at 8MHz or 16MHz. You just solder it and a couple of extra capacitors to the spaces provided on the PCB and relocate the jumpers as instructed.

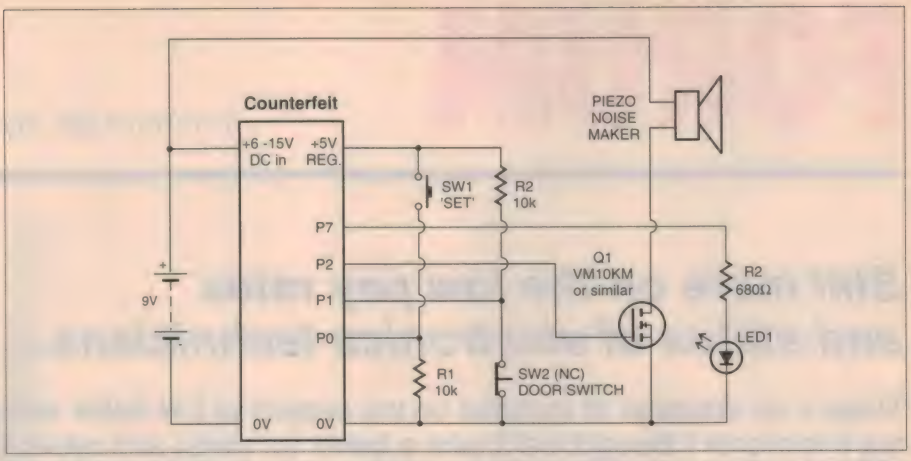


Fig.1: The author's circuit for a simple security system using the Counterfeit (or BASIC Stamp) module. The program needed is listed in Fig.2 below. Operation is explained in the text.

Summing up, we liked the Counterfeit and found it good value for money. But what can it do? If you can get it to flash an LED you can, with a little bit of ingenuity, get it to do almost anything.

We thought we'd like to make it guard the front door. Fig.1 shows the items we need. A pushbutton (S1) connected to pin p0 is used to set the circuit ready for action. A normally closed switch (S2) connected to pin 1 detects when the door has been opened; this can be any sort of microswitch in contact with the door, or one of the special reed switches mounted on the door frame which are held closed by a magnet mounted on the door. When the door is opened, the switch springs open.

Fig.2: Security System Program

```
low 2:                low 7
set:
if pin0 = 1 then delay
goto set
delay:
high 7: pause 30000: low 7
armed:
if pin1 = 1 then alarm
goto armed
alarm:
pause 20000: high 2
```

(We are referring to a door, but actually you could have reed switches on every door and window in the house, all connected in series in a large loop. When any one of these is opened, or an intruder cuts the wires, the circuit is broken and the event is registered by the Counterfeit.)

There is a VN10KM or similar power MOSFET connected to pin p2, to turn on a piezo noisemaker or other audible-warning device when this pin goes high. The MOSFET can drive one of those really loud piezos. Finally, there is an LED with series resistor connected to pin p7. This is an option, but it is useful when setting up the program.

The program needed for this simple security system is shown in Fig.2. Without explaining the syntax in detail, the first thing is to turn off the piezo and the LED, should their pins happen to be high. The program then waits for pin 0 to become high, that is for the pushbutton to be pressed. You do this to set the system, for example, if you are leaving the house.

There is then a pause of 30 seconds, to give you time to get out and close (and lock) the door behind you. The LED is lit during this period, but goes out after 30 seconds, to show that the system is armed.

Nothing more happens until an intruder breaks the loop by opening a door. Then the program jumps to 'alarm' and, after a delay of 20 seconds, turns on the piezo noisemaker. It stays on, even if the door is shut again. The only way to stop it is to turn off the power or to press the reset button on the Counterfeit, which should be hidden away where an intruder is not likely to find it in a hurry.

When you come home again you have 20 seconds to open the door and rush to press the reset button.

As you can see, it's really easy to use the Counterfeit (or Stamp) to do quite useful things.

For further information on either the Counterfeit or the BASIC Stamp, contact supplier MicroZed Computers at PO Box 634, Armidale NSW 2350. Phone (067) 72 2777 or fax (067) 72 8987. Their Web site is at **http://www.microzed.com.au/~microzed**, or you can e-mail them at **bob@microzed.com.au**. ❖

FORUM

Conducted by Jim Rowe

Still more on the low pay rates and status of electronics technicians...

There's no shortage of material on the subject of EM fields and possible associated health risks, but this month I thought we'd take a break (of sorts) and return to another thorny subject: the relatively low pay rates for electronics technicians. The letters keep on rolling in about this one, too.

You may recall that we last discussed the subject of pay rates for electronics technicians in the March issue, with contributions by readers M.M. Gell of South Australia, Jack Gill of Tasmania and Marcin Frankowski who is originally from Poland but current living in New Zealand. All three were adding their comments to those made by others in the September 1996 column, responding to a heartfelt letter by 'P.R.' that I'd published in the previous June.

Mr Frankowski's letter in particular was expressed with a great deal of feeling, and attracted a fair bit of comment. In fact it seems to have been this letter that has mainly prompted further responses, including those we're going to look at now.

One of these came from Jack Gill, whose earlier letter was featured in the March column along with Mr Frankowski's. Mr Gill was prompted to send the following response:

Mr Frankowski's letter in the March edition raised some controversial subjects that I feel compelled to answer (defend).

At the onset, I must state that I cannot compare by personal experience the situation that Mr Frankowski finds himself in, in New Zealand. I can only relay to him my heartfelt sympathy for his obvious disappointment in arriving in a new country, only to find it falls far below his expectations, and examine the reasons why he feels the way he does.

Living in Tasmania for the last 30 years (I originally came from Sydney), I can appreciate the economics of scale and distance from our respective world markets. As well I will comment on the social attitudes that he raised, and the reasons for this, and offer a proposal of my own to increase the profile of professional electronics and engineering in education.

Our combined countries' population is about 21 million people, and just over 200 years young (since European occupation). You are right Mr Frankowski, we are only just advancing from the colonialists phase. I can remember very well that when I left school (in 1962), a lingering perception was that it didn't matter if your scholiastic achievements were below standard, the country needed hard workers anyhow.

Our convict heritage has had a major bearing on this. Of Australia's early settlers how many were scientists? Very few, for these were needed at home! This country offered opportunities to those prepared to work hard in a young developing nation. This accounts for the different attitudes displayed towards those who work with their brains and those who work with their backs. Many of these hard workers are still alive today. We respect and admire them for what they achieved, but we are on the threshold of change. Much of the hard work is being replaced by machines. We now have a real need to advance our technological skill base.

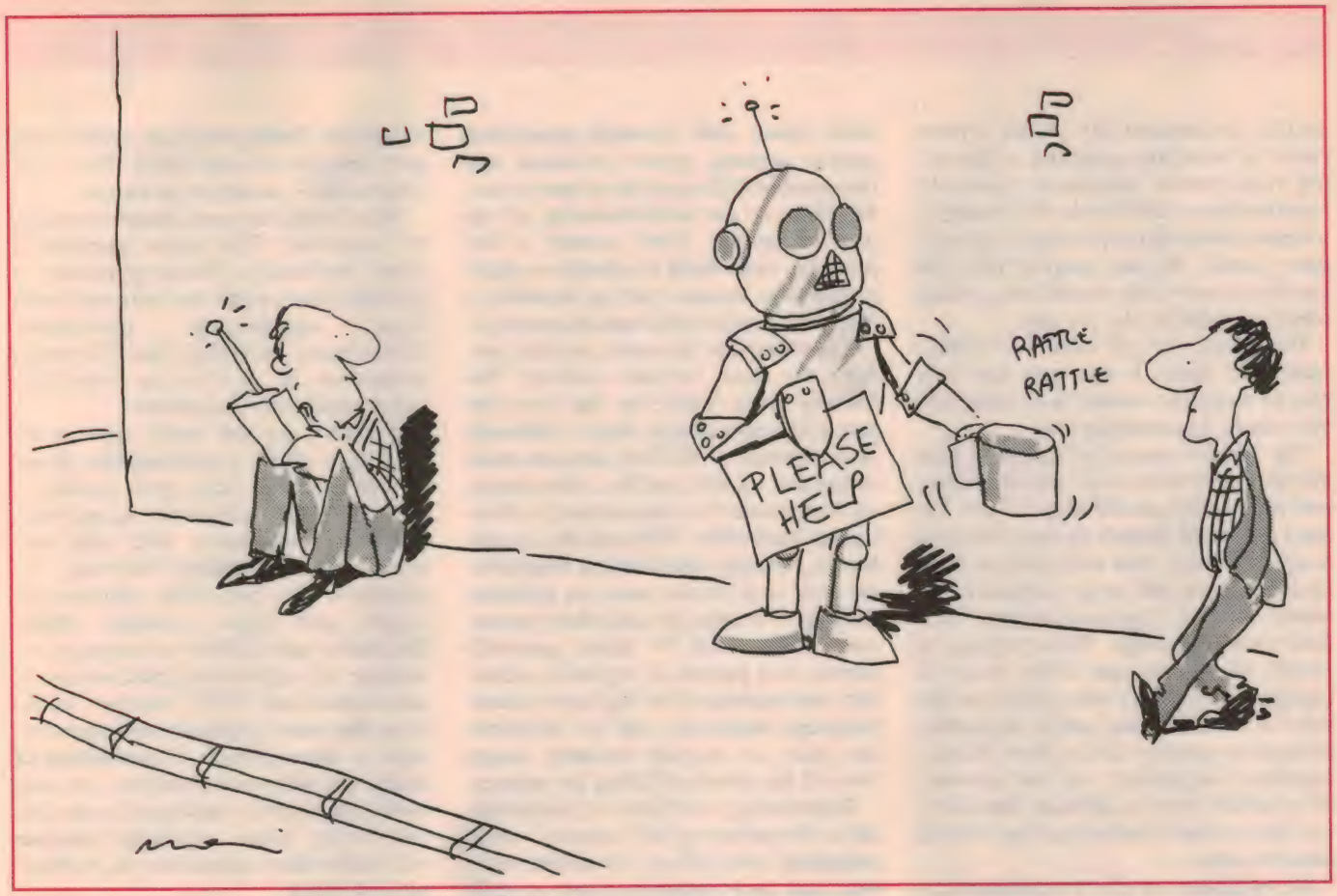
Mr Frankowski was also correct when he suggests that Europeans appreciate the practical skills of technology due to their long history of armed conflicts and subsequent rebuilding commenced by their technical people. This is the single most important difference between Australia and Europe, and is the reason why we view business people differently.

Australia is an egalitarian society, we believe that all people should have equal political and social rights. We do not have the same historical comparisons as those in Europe have. With the exception of the Eureka Stockade, and the later mostly peaceful APPM dispute (by the way I was an active participant in the APPM dispute) we have not seen first hand the wartime profiteering, graft and de-facto collaborating with the enemy he speaks about in his letter. I hope we never do. If our attitudes towards intellectuals suffers because of our egalitarian society, then it is up to us to change it. There are other ways to achieve this rather than going down the same war-torn path as Europe.

The public ignorance to the time and effort required to learn necessary skills in scientific endeavours does not exist, rather, the public is responding to the lack of a high profile by the quiet achievers in this field. There is an old saying that is appropriate here: "The squeakiest wheel gets the most grease!" It's about time an attempt to lift this profile was made by those who have the will to do so. The answer is as simple as learning how to squeak loudly!

We need to follow the skills recognition and reward system used in Europe and unite the profession through active industrial representation. It is only possible to bring about change by this method if we want a peaceful solution. A major shift in public attitudes will come about through this as well. An effective union is the starting point here.

I will give an example of the change I mentioned earlier. As a means of lifting the profile (in Tasmania) of electronics, engineering and the practical skills (as well as enhancing the tourists trade) I have floated this proposal of a radical approach to skills development. The idea was born due to the necessity of approaching the job opportunities available within an isolated (relatively) society differently. Distance to world markets causes additional costs and time delays and limits manufacturing based growth. It follows that most large manufactured items are just not economically possible to export. There are the obvious exceptions to this where Australia is well placed to compete, but these have



factors that give us the competitive edge such as climate for wool production.

My proposal relies on cooperation between schools, government, tourist operators and students and this is it. For government to supply free of charge materials to schools to build robotics theme displays. The theme displays become major school curriculum and when completed are placed in the popular tourists locations. The expected spinoff is for more students to be simulated into electronics, engineering, arts and design. From here they will be encouraged to progress into, and develop, industries specialising in technology. This is for Australian and world markets.

The government can recover some capital cost by charging a small rental of these theme displays to local councils, and to the tourists operators who use them. The tourists operators can provide exciting attractions for their visitors at a reasonable cost. The state will benefit through increased visitor numbers and by the expanding of our technology based industries. I have envisaged detailed plans for this but space does not allow the complete picture.

Australia is still the land of opportunity, Mr Frankowski. We need suitably qualified and experienced people, such as yourself, to ensure all opportunities are realised. People with vision, persistence and knowledge. People who like our immigrant hard workers of past years, can contribute skills and ideas through more hard work (not manual) and experiences from back home. Don't give up on us yet, we may be behind Europe in some ways, but we are far advanced in others.

Thanks for those comments, Mr Gill. I for one found the points you made very interesting, and I believe readers will as well. I'm not sure if I fully understand the way your skills development project would work, but wish you luck in getting the Tasmanian authorities to give it favourable consideration. As you say, there's no doubt that countries like Australia and New Zealand really do need to lift their game in developing our technological skills base.

Unions no help?

Moving on, our next contributor after Mr Gill is fellow Tasmanian Peter Guenther, an electronics engineer of Lenah Valley. Mr Guenther sent his response by e-mail:

Clearly the issue of pay rates and status has preoccupied the minds of professionals and para-professionals in the Australian engineering industry for some time. The March 97 Forum discussion on this subject put forward some commonly held ideas which I feel only hint at the problem.

I do not believe better collective bargaining or more widespread unionisation would make a significant improvement. This approach has been exploited in the past in the telecommunications industry where technicians have withdrawn support for this essential service, but the robust nature of current exchange and transmission technologies today makes it difficult to achieve a level of disruption which can be used as a bargaining tool in a suitably short space of time, without deliberate sabotage. The industry is also generally shedding labour at a rate greater than the rate other sectors of the market can absorb it, leading to oversupply of labour and downward pressure on pay rates.

In the non-essential services industry sectors, rapid technology changes and obsolescence of old equipment put a cap on the chargeable labour rates. Equipment is often replaced before it has ever failed, and often the appearance of a fault precipitates an upgrade rather than repair. This again leads to a

decline in demand for skilled technicians, as installing upgrades or providing replacement equipment generally requires lower skill levels. For example, whoever heard of people repairing computer cards? By and large if they fail you buy a new later model one, at half what you paid for the old one.

The reality, as self employed technicians will know, is that you can only charge what the market will bear, and this can be frustratingly low.

The 'freebie mentality' resulting from the the notion that ideas should be free, and only goods should be paid for, has been unhelpful. People design their own houses, fix their own cars, and in business configure and set up computer networks or other high tech systems, with little real knowledge. People trying to justify their jobs see little point in engaging specialists who could quickly solve a problem, and prefer to fumble through by getting advice from friends, suppliers, magazines and the internet, all of which may be dubious. Outsiders are only called in when mission critical failures occur.

Deregulation in the telecommunications industry has exacerbated this trend. It has reached epidemic proportions in some sectors, where one group of professionals can't afford to engage specialists for some tasks themselves, because business is down in their own specialisation. Big businesses with management who don't understand high tech flock to 'total solution providers' rather than try to solve a problem by using their own resources backed by strategically contracted professionals, regardless of the economic and strategic merits of doing so.

Much has been said of the poor status of engineering professions, especially when compared to the medical and legal professions. Although cultural factors are certainly contributors, I would suggest that your suggestion in concluding the March 97 Forum, that the more dynamic state of overseas manufacturing industries is indirectly the reason for higher status and better pay in other developed countries.

Historically Australia's development has been characterised by exploitation of natural resources. People planted crops or grazed animals on a huge scale, with low costs in a world hungry for agricultural products, and became wealthy. Others extracted minerals as world demand escalated. Some bought land cheap and through population growth demand, prices increased and they made a killing on the property market. This is our understanding of the path to success. Until recently, it has probably been hard to identify a single person who became rich by inventing a high tech product and manufacturing it.

Countries like Germany provide perhaps the most extreme contrast. The country lacks resources, but over the last 150 years people have constantly been exposed to the link between innovation and wealth, and the entire economy is dependent on maintaining technological leadership. Although the country has its property and banking magnates, the most well known ones are Daimler, Siemens, Porsche, etc and their successors. Movies and TV shows generally portray rich people as engineers, scientists and managers in high tech manufacturing industries, and on occasions the plot for murder mystery series Derrick has involved killing for patents.

Engineering excellence is fundamental to the success of the country's technological enterprises on world markets, and such industries foster equally high tech support services. The government recognises this and uses regulation and incentive schemes to make sure it stays that way. The same patterns for success have emerged in selected areas of the USA, notably Silicon Valley, and are well known in Sweden, Switzerland and Finland.

Innovation & wealth

In Germany, one job in six depends on the automotive industry, and probably one in three depends directly on technological industries. Even the simplest commoner understands the relationship between technological innovation and wealth, and I suggest that this is the reason for the high status of engineers and technicians there. The huge size of the manufacturing sector creates the demand for engineers and technicians, and the highly unionised workforce has ensured this has resulted in the world's highest wages based on hourly rate.

Make no mistake however, a concerted assault is being made on countries like Germany and Sweden by the tiger economies of Asia, notably Taiwan and Korea, and some industry sectors like shipbuilding and consumer electronics are reeling as a result, with massive unemployment occurring. People who have long had an expectation of high wages are finding they can either work part time for less pay (as in VW), or be retrenched — union or no union.

What could turn our situation around in Australia? The recent success of some technological entrepreneurs is showing that wealth and jobs can result from engineering innovation. Government initiatives like Victoria's initiatives in multimedia industries acknowledge the possibilities.

However, we are really only at the beginning of the transformation of our wealth creation base from resources and services to manufacturing and technological innovation, and until this process is substantially underway, the prospects for improved engineering wages and status remains bleak. Engineers have lobbied to increase the number of engineering placements at universities and TAFE colleges, in the hope that smart graduates will somehow lead to more growth in technological industries, but many engineers are currently inefficiently employed in the service sector where structural changes will make them redundant, so oversupply will result.

Serious deficit

We need to recognise that demand must come first. Australia has a serious trade deficit in technology which will become unsustainable in a world of flat demand and intense competition from the second and third world in resources. A concerted national strategy led by Government is required to address this problem, and as technological industries and exports grow, jobs and wages across the board will grow with them.

This doesn't mean just throwing money at the problem, but rather changing the entire strategic focus of the Australian economy. Property and resource investment must become less attractive vis-a-vis high tech. If we identify an unsolved problem, we should solve it if world market potential exists, rather than stalling a project and waiting to 'buy in a solution' from elsewhere. The low wage structure, resourcefulness and high skill level of Australia's engineers and technicians are a competitive advantage which must be exploited to the max.

A national strategy would encompass a vision of what Australia will be like in the future, where it would fit into the global scheme of things, and create some certainty in demand for particular

technologies. This is what leadership is all about, but worryingly we've seen little to date.

Thanks for your comments too, Mr Guenther, and what you say about the need for changing the strategic focus of the Australian economy makes a lot of sense. However like you, I guess I'm a bit pessimistic about us seeing this kind of real leadership. We certainly don't seem to have seen much yet, I agree, and I can't help but feel that somehow Australia's politicians in particular are still locked into the old concept of this country being an exporter of agricultural produce and natural resources, and an importer of high tech...

Holiday resort Oz

Moving on again, though, our next contributor comes from a reader living quite a distance away from Jack Gill and Peter Guenther. It's Mr A. Brown, of Mackay in Queensland, and here's the section of his letter that I thought you'd find of most interest:

There are several philosophies in management of business, either manufacturing something or providing a service. One philosophy (a) holds that profit, month by month, or quarter by quarter, is all that matters; the other (b) looks to long-term profit and viability.

One example of (a) is a factory making some goods in this end of Australia; they employed an operator-mechanic, until the volume of work increased and a full-time mechanic was needed. The new man was called into the office one day by the managing director, who commented that a lot of spare parts had been purchased.

"The machines have been neglected, the parts are needed," said the mechanic. The old man stroked his goatee beard. "We'll set a budget, and what you don't spend will be your bonus." From then on, you can guess the state of the machines.

A similar business had many branches. Each year a budget was set, and when some branches fell short, the message was sent to the better-performing branches: "Cut your expenses, we expect an extra $50,000 from you before the end of the budget year." This was like having a golden egg daily from a goose, but when greed grew, the farmer was told to squeeze the goose occasionally until an extra egg appeared; only once a month or so, but still an extra profit.

In the book 'Company of Heralds', an unusually frank book about the Sydney Morning Herald newspaper, Gavin Souter claimed that for some time a director of the company successfully persuaded the board that the newspaper should not make a profit, that the other businesses of the group, chiefly TV stations, should make up the shortfall — that TV should carry the newspaper and avoid any need to increase the cover price or the advertising rates.

In another newspaper group, where the group owns papers in many towns, all are expected to make a profit, except where it is accepted that profits are almost impossible, but it is necessary to try to keep competitors out.

In many companies, it is the practice to reward personnel by their results in their own particular department, without any cognisance of the effect of that particular department's activities on the overall results of the company. I can think of one where it became blatant that a department would cause problems in another department (and resulting down-grading of results) just for a small improvement in the first department's apparent figures.

When Japan began to make reliable goods, the results showed up in USA; it has been reported that there are now no manufacturers of TV receivers in USA, and the reason is obvious.

The countries of East Asia will become the leading economic group in the 21st century, displacing USA. This will have its base in the enormous size of China and the technology of Japan. This

has already been decided. The entrepreneurs will seek customer satisfaction, not short-term profit.

It has also been reported that this East Asian conglomerate has decided to keep Australia as a holiday resort, and possible source of raw materials; but the advantages of Australia as a holiday resort will not be compromised.

We must lift our game if we are to survive.

Thanks for those comments too, Mr Brown. I guess one of the points you're making is that Australian companies are often rather short sighted about the need to invest for the future — whereas those in many of the countries to our north tend to take a much longer view. I'm sure you're right, but I'm not at all confident that in Australia enough people do *want* to 'lift our game', even to the degree needed to avoid the 'holiday resort' only scenario...

Society vs 'trade'

And so to our final contribution this month to this topic. It comes from Alan McCallum, of Heywood in Victoria, who has this to say:

Thanks for publishing most of the letter from Marcin Frankowski. Mr Frankowski does get at some of the issues of the low status of technicians, but I think there is more to the subject than he has seen.

Firstly, in English speaking countries like Australia and New Zealand, there really is a serious divide between technical and non-technical areas. This divide is historical, and stems mainly from the British class system. People from all levels in non-technical callings always have higher status than technical workers, even in job ads. In Australia technical people at all levels really do have (and have always had) lower social status, and as a result lower pay.

Secondly, in Australia, the advantages of being in a union used to depend entirely on which industry you worked in. Formerly, an electrician with industrial electronics training would be well paid at sea, reasonably paid in the construction industry, poorly paid in a factory as a maintenance electrician, and very badly paid (even if working on highly technical equipment) at a Naval Dockyard. In each of these enterprise work sites, strong unions supposedly looked after workers.

Nevertheless, in the mid 80s, the leadership of the Institute of Marine and Power Engineers, from a position of self-interest, opted for the exclusion of properly trained electricians from Australian shipping, and to allow marine engineers to take over their work under the rubric of 'multi skilling'. Electricians have all but disappeared from the few remaining Australian ships, as a result. This powerful union was next to useless for electricians.

Or take the situation at Portland Aluminium, where there are no instrument technicians or electronic technicians, only electricians. In fact there are nominally only two trades, electrician and fitter. When the plant started, the original designers planned and built well-equipped workshops, but these facilities were never used. All interesting instrument and electronic work is presumably contracted out to product suppliers.

Ten years later, Portland Aluminium is still running without technicians. The new workplace agreements in Australia will continue this trend of squeezing out highly trained technicians, so do not expect anything at all from unions, as in my experience they are completely unable to help workers when faced with challenges to conditions, and to the job re-classifications that inevitably de-skill workers.

Thirdly, the proliferation of graduate engineers without real engineering work to do, has caused an upward drift in the qualifications necessary (for instance) to do commissioning work on industrial projects. Engineers are now doing work that only a few years ago was done by tradesmen and technicians; work such as wiring checks, initial testing of motors, tuning process instruments and similar tasks. This is the true legacy of the Dawkins reforms to education in Australia. Diploma TAFE colleges upgraded to 'universities', the binary system of technical training was abandoned and diplomas and other certificates were devalued.

As a result there is now an over-supply of young degree engineers, and an undersupply of practically trained electricians who have upgraded to certificate level. Whether the engineers are appropriately trained for the work they are taking on is debatable, and whether the underuse of their well developed theoretical skills is useful to the country remains to be seen, but personally I do not think so. In this regard, European practice is much more realistic, as highly trained workers with skills between engineers and installers are still well regarded.

I hope that young technicians have a better future than has been the case in the last 10 years or so, but this will take a radical change of culture in Australia. I do not expect this to happen, and I rather morosely expect that our industrial base will continue its relentless decline, given the standard of 'leadership' from both political parties.

I certainly would not recommend intermediate level technical work as a career option. It would be much safer to get into bartending, or to learn how to drive a floor polisher at a casino.

Hmmm — thanks for those sobering but thought-provoking comments, Alan. The points you make are very relevant, and I wouldn't be at all surprised if they generate as many responses as Mr Frankjowski's letter has done.

As you suggest, the trend towards companies 'out sourcing' many of their technical skills is almost certainly reducing the number of jobs for people with technician-level training, while at the same time reducing whatever effectiveness the unions might have had in protecting the pay and status of their members. It's also more or less forcing technical people to start their own business, in order to survive as a 'contractor' — and regardless of our technical expertise, we don't all have the skills to run our own business, do we?

But that's about all we have space for, this month. I'll try to wade through some more of the material on EM fields and health, so we can look at it again next month. See you then? ❖

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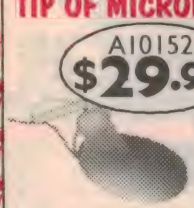

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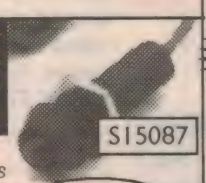

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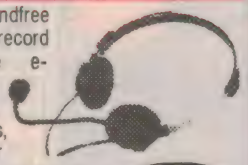

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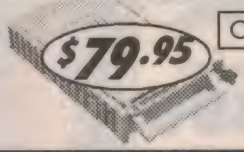

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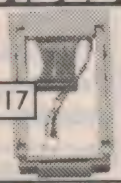

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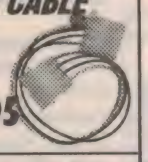

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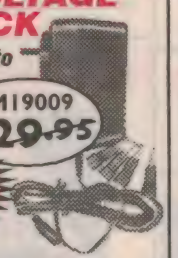

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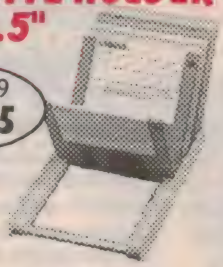

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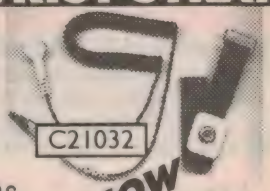

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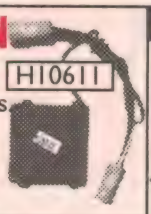

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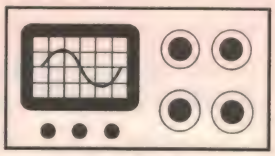


The desoldering gun that can explode in your hand!

Our first story this month comes from an engineer, warning from direct experience about a desoldering gun that can explode in your hand, due to what appears to be a design fault. There's also a tale about an ingenious repair to an elderly VCR with a faulty SYSCON chip (without replacing the chip!), and another about a guitar amplifier with a fault that though unexpected, turned out to be surprisingly easy to fix.

We start the column this month with a story I rather wish I didn't have to use. I am never happy about 'knocking' a product or manufacturer, since I like to believe that most products are placed on the market in good faith. I'll agree that there are many cases of bad design, but I'm sure these are the result of accident or carelessness; I can't accept that they are the result of deliberate malice.

The story that follows certainly fits into the former category, in any case. It comes from Daniel Ford, of Beecroft in New South Wales. Daniel has found what appears to me to be a case of a designer forgetting to think right through to the end use of his design. This product would have been perfectly safe if it had never been used!

Here's what Daniel has to say. He's called the story 'Desoldering Danger':

With the introduction some years ago of fully self-contained handheld desoldering tools, many of us in the service and R&D industries leapt upon these instruments as the ideal solution to the problem of through-hole component replacement in PCBs, in and out of the workshop.

One particular model, the 'DIC' SC-5000 and its successors, rapidly gained popularity. This story is a warning to all those users of these tools, and a plea to the manufacturer (Den-on Instruments Company Ltd, Japan) to urgently revise their design to make the tool safer.

After moderate use, these tools can 'blow-up', possibly causing burns to your hand. It's even likely to cause more serious burns to the legs if the hot tool is dropped in shock as it blows up in your hand.

I'm a professional engineer, specialising in the design of industrial microcontroller systems (both hardware and software). From time to time I need to remove components from a PCB, whether for prototype changes or repairs to faulty boards manufactured by my clients.

I decided long ago that solder-suckers and solder-wick were not very efficient for large volumes of desoldering (ICs for example) — especially on multilayer PCBs with a ground plane, which tends to drain away much of the heat applied to a solder joint. So I invested in an SC-5000 desoldering tool. This tool worked well and I used it effectively for several years (later models were subsequently released, but I saw no need to update as mine still did the job perfectly).

The photograph in Fig.1 shows a general view of the SC-5000. An electric motor built into the handle is coupled to a simple diaphragm pump. Also in the handle is a control circuit which maintains the heated tip at a set temperature (user adjustable via a trimpot accessible from the bottom of the handle).

The heated tip is applied to the pin to be desoldered, until the solder is melted. When the trigger is depressed the motor runs and sucks molten solder through the hollow tip and barrel to a glass filter chamber where the solder is collected. When all the pins of a device have been cleared of solder, the device is easily lifted out.

Provided the nozzle and barrel are kept clean (a cleaning wire for this purpose is stored in the SC-5000's handle) and the filter is not blocked (this takes quite a few years of sporadic use), the tool works very well.

The SC-5000 is not supplied with any kind of stand, so when using it I would lie it on its side on the bench, clear of any objects which might accidentally come into contact with its tip.

A recent project was the design and development of a micro-stepping motor drive card, running from 120V DC, and supplying up to 5.5 amps to each of the three motor phases. The single Eurocard also contains a microcontroller which performs various motor command, analog scanning and host communication functions.

Needless to say, when debugging a board of this complexity, handling these levels of voltage and current, blowups of some of the MOSFETs are almost inevitable. So the SC-5000 was in constant use for a short time.

On one occasion, as I picked up the tool from the bench, it issued a loud bang and spewed sparks and smoke out of the vent slots at the base of the handle. As it continued to crackle and pop and to belch sparks and smoke, I quickly dropped it back on the bench. It soon stopped erupting, but did not blow the mains fuse.

The entire palm of my right hand was

black. Luckily I did not sustain any injury. If you look again at Fig.1, you'll notice some burn marks high on the handle, well away from the vent slots. The handle was slightly pitted in this area, suggesting that molten metal was deflected from my palm back onto the handle.

I was very lucky not to have sustained burns, and it could have been to more than just my hand. Had the explosion occurred while I was holding the tool in front of me, I could have dropped the hot tool in fright, straight into my lap, causing serious burns to my legs (or other body parts).

I quickly unplugged the tool and after recovering my composure, and resolved to write about the incident to (hopefully) prevent a similar injury to other users of this model tool. I first photographed the handle, to show the burn marks, and then commenced dismantling the tool. After separating the two halves of the body, the cause of the explosion became obvious.

Because of the severe blackening of the area inside the base of the handle, it may not be very clear in the photograph (Fig.2), this area being almost too dark for the latitude of normal colour film. But if you look closely you may be able to discern four large holes in the base of the motor, which go clear through to the rotor chamber. The circular PCB normally sits directly below the bottom of the motor. This PCB terminates the 240V mains cord and contains the temperature control circuitry.

Now, as anyone who has worked for some time with brush type electric motors will know, the brushes (which are made from soft carbon or graphite) wear away over time. Some of the brush particles burn up and disappear as smoke, but other particles are simply ground away and fall about inside the motor.

In this particular tool, which in use is held with the handle vertical, where do you suppose these conductive brush particles fall? Clearly some of them fall through the four large holes in the base of the motor, on to the unprotected PCB immediately below — a PCB connected to the 240V mains!

Sooner or later it was inevitable that a short-circuit would occur, and most people involved in the service of mains-powered appliances will know what a wallop the mains can deliver, even before the fuse blows. Hence the fireworks.

I consider this to be a glaring design defect in this model of desoldering tool. It is possible that the PCB assembly had been sprayed by the manufacturer with some sort of protective lacquer (it was too charred to determine this), but clearly any protection which might have been there was inadequate.

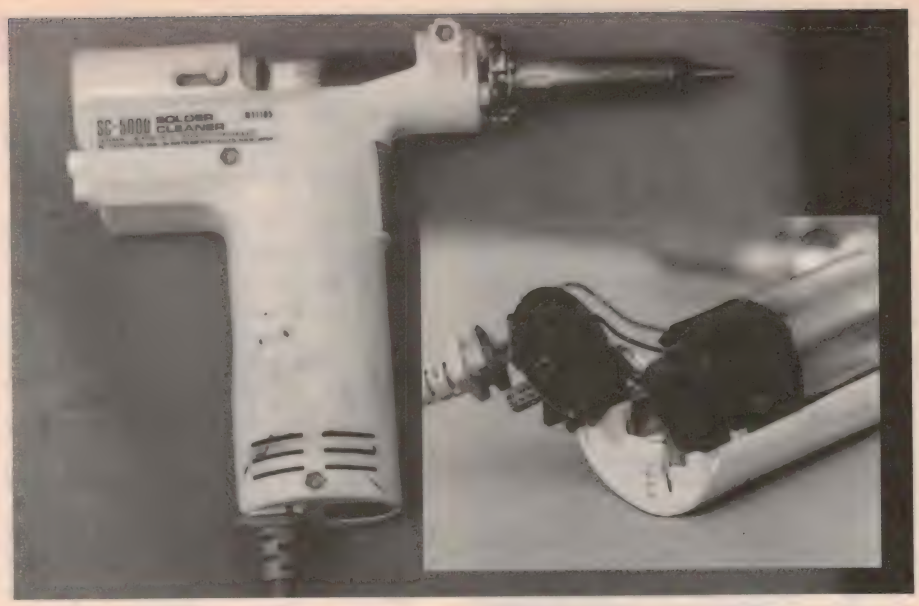


Fig.1: Two views of the SC-5000 desoldering tool that exploded, as supplied by Daniel Ford. The inset shot at lower right (Fig.2) shows the PCB lifted from its vulnerable position below the motor.

I would strongly recommend to other owners of this model desoldering tool (and its successors; I believe SC-7000 is the current model from DIC) that they dismantle their tool and remove any build-up of brush particles from the PCB below the motor. It would also be worth spraying the top surface of the PCB assembly with an insulating coating, and maybe even making a disc of suitable plastic to place over the PCB assembly.

Inspection and cleaning should then be done at regular intervals, the period between inspections depending on the amount of use the tools gets.

I also appeal to the manufacturer to revise the design of this tool (if the current model has a similar construction), so that this problem cannot occur again.

Since I still needed a desoldering tool while the SC-5000 was being repaired, I looked at alternative self-contained types. I passed over the cheaper brands, believing that quality is a feature that has to be paid for.

I finally settled for the Hakko 808, which has the motor mounted horizontally in the main body rather than vertically in the handle. Without having had a chance to dismantle the Hakko tool for investigation, I believe this might be a safer arrangement.

In a few respects it is inferior to the DIC models, although it does the job for which I bought it. In particular, the filter arrangement is less satisfactory, having two filter components, the first of which is consumed rather quickly as the buildup of solder is peeled from it during cleaning. (In the DIC tools, the solder never reaches the one-stage filter.)

A second unsatisfactory aspect of the Hakko is that a component of some kind is mounted in the handle (which is thinner than the DIC model, since it does not contain a motor). This is probably the temperature control circuitry, since it causes the handle to become unbearably hot while lying on its side on the bench. (The Hakko is another model that is not supplied with a bench stand).

And finally, the nozzle-cleaning wire provided with the Hakko does not store in the tool itself and so is likely to become misplaced amongst the bench clutter. More particularly, it might be forgotten when going out on a field service (and Murphy will ensure that this is most likely when cleaning will be needed!).

Thanks for that story, Daniel. It's a salutary warning that should be heeded by everyone who uses that brand of tool. It's a pity to have to warn users about a design fault in otherwise good equipment, but as I mentioned at the start, some designers do not think their work right through.

And again, it's a pity to have to criticise a Hakko product as well, because this brand has a reputation for good design and workmanship. In particular, the hot handle seems to me to be a bad feature of the design. Daniel, I wonder if your instrument might be a tad faulty and that other examples of the same model might be more user friendly?

Finally, it's a pity that we have to buy and use a product before we learn about its faults and inefficiencies. I

myself have several soldering tools and a number of other tools and instruments that never did live up to my expectations, or their makers' promotional excesses. I suppose that stories like Daniel's are necessary, as warnings that we shouldn't take the maker's claims at full value.

Thanks again, Daniel. Those high powered stepper motors sound interesting. Do you think we might hear more about that line of work?

Backward thinking?

Now we come to a contribution from a well known correspondent, Doug Thwaites of Esk, in Queensland. Doug has given us a number of stories in recent years, but this one probably takes the cake for ingenuity. As you'll see, he has taken a step backwards to replace modern solid state technology with a century-old mechanical equivalent. Read on, to see what he has been up to:

I have been servicing for the last 50 years, but I can still come across the occasional fault that I have never met before. This time, a customer brought in a Sharp VCR Model VC 583X and told me that it would "...go backwards but not forwards!"

If I had collected and published all the oddball fault descriptions I have heard over the years, it would probably be a best seller. But when I got this one on the bench, I found that the customer was right!

The reel motor would rewind the tape, but would not fast forward it. Of course that meant you could neither play nor record, as the tape would not be taken up as it came out of the capstan roller.

Reference to the circuit diagram showed that one chip, IC702, controls the direction of the reel motor. However, in the chassis I had before me, ICs 701 and 702 are combined into a single 14-pin chip with a metal heatsink. The pins on one side of the chip control the capstan motor and the pins on the other side control the reel motor.

Two pins input to a F/R detector and decide which way the reel motor turns. Once again there was a problem — the voltages shown on these pins on the diagram show 9V (F) and 9V (R) on one pin and 0V and 0V for each state on the other. Do they deliberately intend to mislead us?

Obviously these pins should have 9V and 0V alternately, to change the direction of the motor, and I checked that this was so. Press REW and there was 9V on one pin and the motor ran, press FF and the other pin goes high to 9V but the motor didn't run. That suggested to me that the SYSCON system was OK, but it seemed that the reel motor direction switch was faulty.

I must be getting old because it wasn't a faulty chip, as I found as soon as I fitted a new one. So what had I done wrong? I had checked the changeover of the 9V pin, but not the other one — which should have gone to 0V. I found that this happened in REW where there was 0V on the opposite pin. But on FF, there was a steady 5V!

Tracing the feed to these two pins I found that it came directly from pins 26 and 27 on the SYSCON microprocessor. I concluded that inside this chip and feeding these two pins there were a series of transistors which not only took them high to 9V but also dragged them down to 0V when needed. One of these circuits must have failed and pin 26 could not be taken and kept at 0V.

When I costed a new SYSCON chip and the labour involved in changing it, the customer decided it wasn't worth it for an old machine.

Then thinking about it that night in bed (the only free time I get to think), it seemed that all that was needed was that pin 26 had to be kept at 0V potential when pin 27 went high. Why change the chip, when everything else worked perfectly?

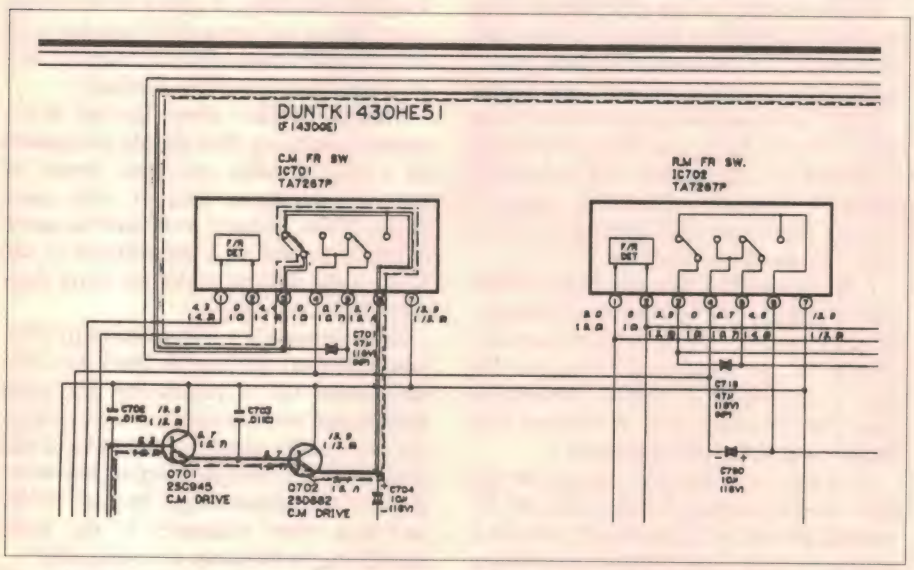
The next morning I mounted a 5V relay on a piece of matrix board with two transistors to activate it when pin 27 went high. I used two transistors to reduce to microamps the current drawn by the relay.

I hooked it all up and Bingo! It worked and is still working weeks after. I was happy and so was the customer. It's problems like this that keeps me interested in servicing.

Well, Doug. That story puts a new meaning on Backward Compatibility! Any number of people have rigged solid state replacements for an old mechanical device. You are the first I've heard of going the other way. I've heard about thinking laterally, but but Doug seems to have 'thunk backwards' for this one.

Thanks for the story, Doug. Perhaps it will give others some ideas for economical repairs to otherwise useless machines.

(Editor's Note: As the relationship between the two pins on the SYSCON chip seems to be basically just inversion, it might have been possible to use just a transistor or two to pull the 'pin 26' line low when pin 27 went high. In other words, the relay might not have been strictly necessary. Of course this doesn't detract from Doug Thwaites' ingenuity, in finding a low-cost alternative to replacing the SYSCON chip altogether.)



A snippet from the Sharp schematic for a VC 583X VCR, showing how IC701 and IC702 are essentially solid-state relays. When one chip developed a fault, Doug Thwaites came up with a low-cost solution.

Strange circuit

Our next story comes from Mr G.D. Mayman, of Dover Gardens in South Australia. It's a computer story, about a

subject that sounds as though it might become one of the common faults in PCs. Here's what Mr Mayman has to say...

I had a similar experience to that of Eric Rodda (Serviceman, March 1997) with a secondhand 386 board where the CMOS RAM was holding up, but the clock would stop whenever the power went off.

I noticed that the three-cell NiCad battery was showing signs of corrosion at one end, so I purchased a new one. But before fitting it, I did some investigation of the charging circuit. I found it went from the 5V rail to a blocking diode, to prevent the NiCad from discharging back into the computer, then via a series 1k resistor and another diode, from its orientation apparently a zener.

The voltages measured with my trusty analog meter were: Supply rail 5.0V; blocking diode, 0.5V; resistor 0V(!) and zener diode, 1.5V. A test with a resistor across the battery terminals showed that a current would flow, but only while the battery terminal voltage was less than 3.0 volts — not good for a nominal 3.6 volt battery. It is not surprising that one cell had 'died'.

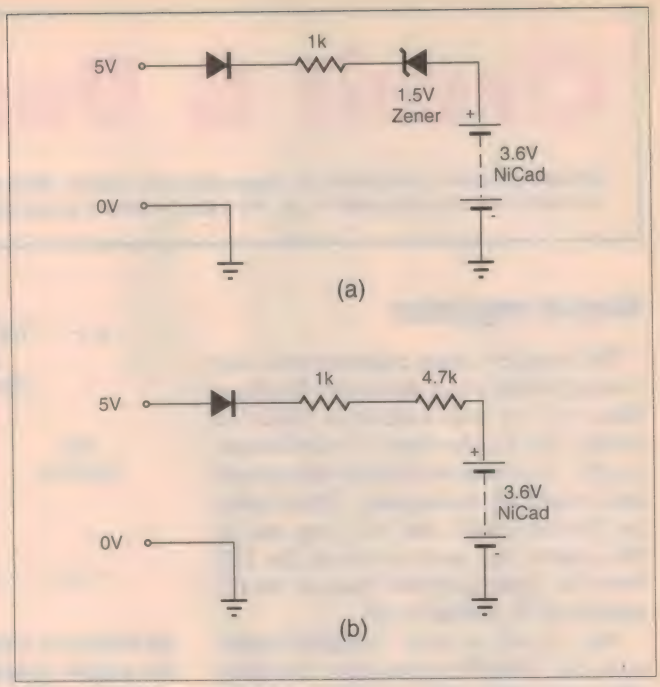
The new battery, I noted, was supplied in a charged condition and after fitting it I measured the drain presented by the clock and the CMOS memory — it was below the readable limit on my analog meter on the 100uA range. I estimate probably about one microamp or less.

It is obvious that the battery, if fully charged when fitted, would be able to hold up the clock and CMOS for a considerable time, maybe several years if the computer was used regularly for prolonged periods; and that by the time it went flat, the computer would probably be due for an upgrade anyway.

My solution to the problem was to remove the 1.5 volt zener and replace it with a 1/8 watt, 4.7k resistor. This would provide a charging current reducing to about 200uA when the battery was fully charged. The battery should be able to withstand this indefinitely. Time alone will tell whether the battery will charge sufficiently at this current level, but it is my belief that it will.

I wonder how many other computers have had their backup batteries fail due to this very odd charging circuit? With the prevailing attitude that all boards should be replaced, not repaired, it is unlikely that we will ever know.

When I first read Mr Mayman's description of the charging circuit, I couldn't see how it could possibly charge a 3.6V battery. I even rang him to check that there was no mistake and that I had read his report correctly.



Reader G.D. Mayman struck an X386 computer motherboard with its NiCad memory backup battery charging circuit wired as in (a). No wonder the battery gave trouble! He replaced the 1.5V zener with a 4.7k resistor as shown in (b), and fixed the problem.

Like him, I wonder how many of these motherboards are in circulation, flattening batteries all over the place and setting their owners up for expensive repairs. As in our first story, it sounds like another case of bad design.

Thanks for your story, Mr Mayman. It's good to get away from VCRs and TVs occasionally.

Running dead

Which brings us to the last story for this month, and another one that is out of the ordinary. By an odd coincidence, it comes from the same Eric Rodda who was mentioned in the story above. Eric has been a quite prolific contributor in recent months, with a wide variety of subjects. It seems he is a rather versatile serviceman!

This time he has a short story about manufacturing defects in what looks like a low-end product. But even low-end products should be reasonably well made. This is what Eric found...

My story concerns something that continues to rear its ugly head time after time. The fault was in a guitar amplifier bearing an obscure Asian brand name; a small amplifier of about 15W output. The amp was not giving any sound from the speaker, even though the power light indicated everything was OK!

Once the electronics were extracted from the box, a quick inspection revealed a headphone socket with dry joints on every socket pin. I was able to pry the socket from the board without using a soldering iron and found six shiny pins — none of which had never been properly soldered.

A quick run over with a needle file removed some untinnable plating, then the socket was refitted and soldered to the PCB. The unit was quickly tested before returning it to the case, in a better condition than it had ever been before.

In most amps fitted with headphone sockets the output is usually directed through the switch contacts in the socket. The contacts themselves can often be the cause of no output by acquiring a coating of dirt or corrosion.

We expect this sort of fault and usually look for it in any 'No Sound' condition. But fortunately, it's pretty rare to find the headphone socket not soldered in. That's one problem we can't anticipate!

And it's one problem we can do without, Eric!

Actually, I think Eric solved the riddle in his next to penultimate paragraph, where he reported to have used a needle file to remove some 'untinnable' plating. Most production boards these days are soldered in one action in a wave soldering machine. This covers the whole underside of the board with molten solder and there is no way known that an item could miss the soldering process, unless it was protected by some kind of inactive plating.

Seems to me that the sockets mentioned in Eric's story were wrongly plated and then jobbed out to a low end manufacturer, instead of being junked and/or replated. Things like this don't make our job any easier though, do they?

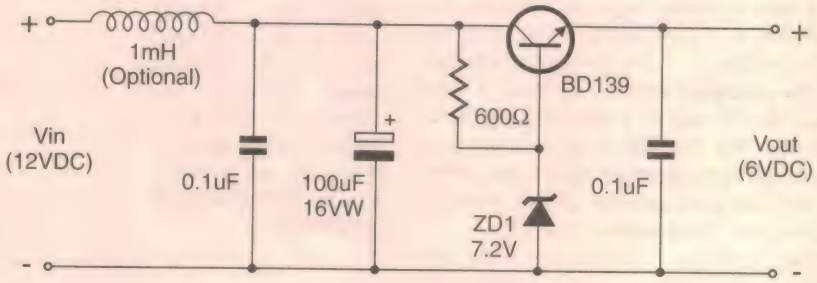
That's all for this month. There'll be more entertaining stories from the service bench next month. ❖

Circuit & Design Ideas

Interesting original circuit ideas and design tips from readers. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

Simple regulator

This simple voltage converter was used to supply power to a digital mobile phone fitted to a car with a universal handsfree car kit. This kit uses four AA sized batteries (6V) to power its external microphone and amplified loudspeaker. Predictably, the batteries didn't last very long and so this adapter was used to convert the 12V from the cigarette lighter down to the 6V needed by the handsfree kit.



The circuit is very straightforward, with the BD139 series-pass transistor able to handle loads requiring up to an amp or so. Zener diode ZD1 provides the reference voltage for the circuit, with the adapter producing an output voltage of 0.6 to 1.2V lower than the Zener's voltage, depending on the load.

A 7.2V zener diode was used in the prototype, which delivered approximately 6V to the handsfree kit.

Graham Cattley, EA staff.

Front panel made easy

While not a circuit idea, this tip might come in handy to those who make front panels for electronic projects.

Due to 3M's recent decision to discontinue production of their range of Scotchcal material, the home constructor will need to turn to other methods of producing presentable front panels for projects.

Since most hobbyists have access to a PC these days, as well as one of the word processor packages that offer a choice of fonts and a drawing package, it is an easy matter to produce a front panel layout with text and simple graphics. This may then be printed out either on a laser or inkjet printer, giving a very acceptable label. A clear adhesive backed clear plastic film (Contact or similar, as used to cover books) is then applied over the top of this artwork.

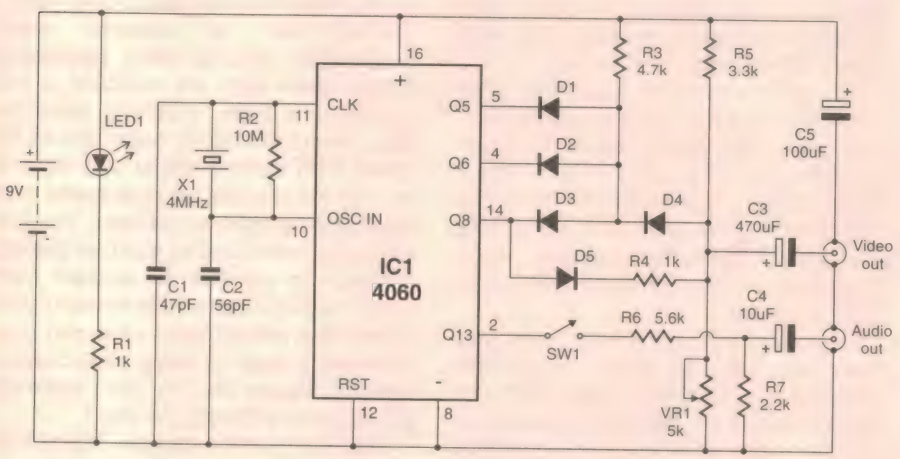
The label may now be fitted to the project's pre-drilled panel, using either a suitable glue or by applying double-sided tape known as 'transfer tape', which is available from 3M company in various widths. I use a roll which is 25.4mm (1") wide (3M type 465 transfer tape, stock #033807-2), and use multiple strips adjacent to each other to cover the whole back of the label.

The result is a very pleasing label with a low gloss protective finish. For some applications, the use of coloured paper stock adds a personal touch — for readers with a colour printer, a very distinctive front panel can be produced.

After fixing the finished label to the panel, holes may be then be cut using a sharp modeling knife, or, in the case of round holes, the shank of a suitably sized drill bit may be used to punch a hole in the label.

Glen Percy
Narre Warren, Vic. **$30**

Video test generator

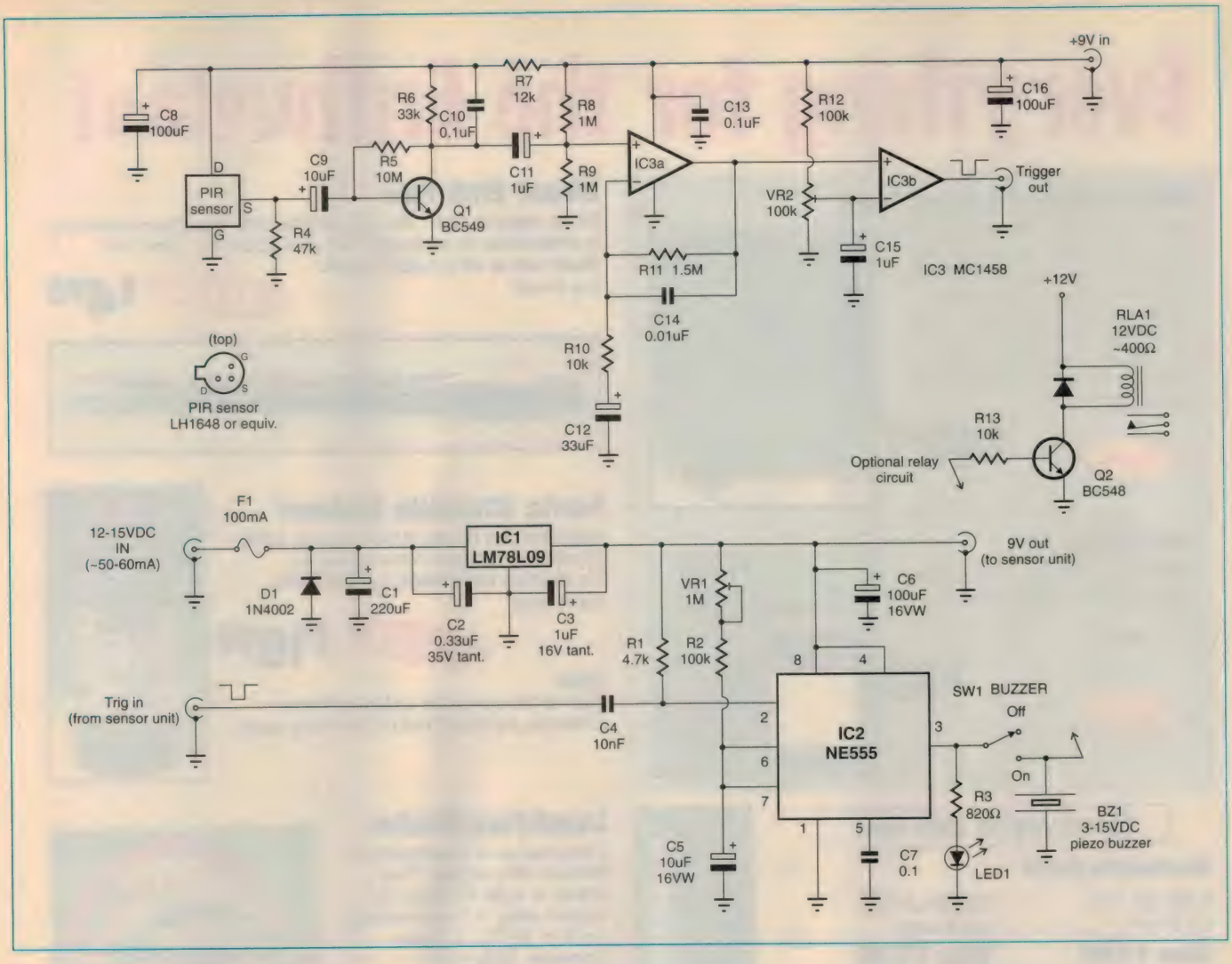


I've developed a video test generator that uses just one IC, and comes in very handy when repairing and soak testing video systems. The circuit produces a blank grey screen, and it can also generates an audio tone as well.

The 4060 (IC1) is clocked at 4MHz by a ceramic resonator or crystal (both work well, but the resonator is usually cheaper). D1-4 form an AND gate which produces the horizontal sync pulses. The diode-resistor network (D5, R4-5, VR1) shape the video signal to provide the grey scale, and the signal is then AC coupled to the output via C3, a 470uF capacitor.

The audio signal is derived from pin 2 of IC1, and is attenuated by R6 and R7 and then AC coupled to the output via C4. SW2 may be omitted and the sound turned off by simply unplugging the audio lead!

Jon Ellis
Norah Head, NSW **$30**



Automatic PIR doorbell

This doorbell informs the occupants of a visitor's arrival before they even reach the door. Although I call it an automatic doorbell, this circuit suits a wide variety of applications, especially when the optional relay is connected.

The PIR (passive infra-red sensor, a Heimann LH1648 or similar) is a dual element type giving a fair degree of sensitivity, and a maximum range of 10-12 metres.

The signal from the sensor is AC coupled to a high gain common emitter stage with a gain of about 500. The signal is then filtered and further amplified by IC3a, half a dual op-amp set to a gain of 150. When present, this signal is detected by IC3b, the remaining half of the dual op-amp wired as a comparator. This sends a negative trigger pulse to the output timer, a 555 with an adjustable output time of about 1 - 12 seconds.

The sensitivity of the sensor unit is adjusted by VR2, a 100k trimpot, and the output 'on' time is set by the 1M trimpot VR1. If required, a longer 'on' time range can be selected by changing the value of the timing capacitor, C5. A 100uF capacitor will give an output time of about 10 seconds to 120 seconds, while a 1000uF gives an output time of 100 seconds up to 1200 seconds.

If an output other than the buzzer is required, a level-shifting transistor Q2 and a relay can be connected in place of (or as well as) the piezo buzzer as shown on the diagram. Note that the relay must be connected to the 12V supply.

In construction, and if you can find one, a Fresnel lens can be mounted in front of the PIR sensor for a wide-angle detection zone, otherwise good results can be obtained by using a pinhole lens, formed by mounting the sensor about 25mm behind a 5mm hole.

Steve Carrol
Timmsvale via Ulong, NSW **$35**

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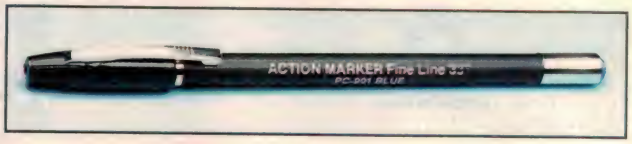

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Watch TV on your PC

This card is three-in-one; a TV tuner, a 2Mb video graphics accelerator and an MPEG playback card. Capture vision from TV, VCR, cable or even a game system like Nintendo 64. Play back, or output them to s-video or a monitor-all with crystal clear clarity at full screen size! This pack also comes with a CD ROM game and MPEG movie. Installation is available *.

Cat X-8137

$499

Protective Eyewear

Protective Eyewear Spectacles are a must if you spend hours each day in front of a computer or VDU, to protect your eyes. All these spectacles have lens filter block which protect you against UV/UVA wavelengths which are the most harmful to the human eye, as well as 'blue light' which is the most difficult for the eye to focus. Use spectacles and avoid eye strain, double-vision, blurred sight and glare.

1.0 and 1.5 are suggested for people over 35 without prescription glassews. 0.00 are suggested for people under 35 who don't need prescription glasses. Available in two styles, Severn or Mersey, or as clip ons. Use the table below to determine which are best for you.

Over 35 with prescription glasses

Severn 1.50	Cat X-1146
Severn 1.00	Cat X-1177
Severn 1.00	Cat X-1178

Over 35 without prescription glasses

Severn 0.00	Cat X-1175
Mersey 0.00	Cat X-1176

$24.95 ea

Perfect For Electricians And Maintenance Technicians

Fluke 7-600 Digital Multimeter

FLUKE

Ideal for fast voltage and continuity checks, 4000 count display. Low impedance input - eliminates reading "ghost voltages" on non-energised circuits. Includes test leads.

2 Year Warranty

Cat Q-1633

$145

3999 Count Digital Multimeter

NEW

Large 3.75 digit (3999) LCD, pop-out stand, auto-polarity, capacitor/diode/transistor test, logic circuit test, frequency measurement (up to 4MHz), peak reading hold, continuity test, soft carry case and test leads.

Cat Q-1451

$129

Due mid July '97

19 Ranges Plus dB

A compact and reliable multimeter with continuity testing and a wide 20A range. Features high sensitivity (20,000 ohms per volt), mirrored scale for accurate readings and recessed terminals for added safety. Diode and fuse protection.

Cat Q-1023

$29.90

SAVE $10

New High Performance 5mm LEDs

General Electrical Characteristics

Viewing angle:	30 degrees
Forward voltage:	3.6 VDC (Typ), 4VDC (Max)
Forward current:	20mA (Typ), 25mA (Max)

Brilliant White Light LED

Light intensity: 600mcd (Max)
Lens Type: Water Clear
Data and specifications included

Cat Z 4002

$7.95

NEW

Super Bright Blue LED

Light intensity: 500mcd (Max)
Lens Type: Water Clear
Data and specifications included

Cat Z 4007

$6.95

NEW

From Australia's premier supplier of high quality kits

Model Rail Point Controller

- Operate your model railway remotely
- Circuit is designed to operate an optional twin solenoid that is available from most hobby model stores
- Power source required: 12 to 15 volts AC/DC
- Case optional (use H 2853)
- PCB size: 40mm x 52mm

Cat K 3031

$6.60

NEW

Silicon Chip July '97

Regulator For Battery Charger

- Turns a 'bare bones' 12 volt automotive battery charger into a regulated charger
- Circuit can be left connected to a battery indefinitely
- Designed to adapt an Arlec 4 charger or similar unit
- Power source required: 12 volts DC
- Supplied with components, PCB and heatsink bracket
- Case optional (use Charger case)
- PCB size: 65mm x 130mm

Cat K 3127

$25.90

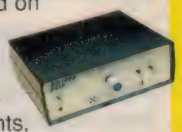
NEW

EA July '97

TV Pattern Generator

NEW

- Generates high quality colour bars
- Produces dot, crosshatch and circle, checkerboard, red and white rastor, colour bars and greyscale
- Patterns correctly centred on screen
- Direct video output plus RFoutput
- Audio input for video modulator (to test sound)
- Patterns and sync stored on ROM with option to change patterns
- Power source required: 240 volts AC
- Supplied with components, hardware, PCB, video modulator, EPROM, case and pre-punched screened front panel



Cat K 7380 Silicon Chip July '97 **$149**

Wave Form Generator

- Frequency range: 10Hz to100KHz
- Both amplitude and frequency are voltage controlled
- Combine two of these to make an audio sweep generator
- On board voltage regulation to ensure good stability
- Power source required: 9 volt battery or any DC supply between 8.5 and 15 volts
- Supplied with components, PCB and hardware such as pots and switches
- Case optional (use H 2851)
- PCB size: 43mm x 87mm

Cat K-2802

$21.50

Multi 555 Timer Circuits

- Circuit uses a 555 timer IC as a building block for timer projects
- Allows a timer or pulse generator to be quickly and cheaply put together with just a few parts
- Capable of operating relays directly, and is easier to set up for those utility projects
- Comprehensive instruction manual supplied showing many circuits and overlays for different timing configurations
- Power source required: 4.5 volts to 16 volts DC
- Supplied with components and PCB
- Case optional (use H 2855)
- PCB size: 44mm x 61mm

Cat K-2813

$16.95

Discovery Series

Dual 12V Battery Controller

- Automatically switches your auxiliary battery into the main electrical system for charging once the engine is started.
- Disengages your main battery when the engine is stopped avoiding excess drain when secondary items are being operated.
- Switches between primary and auxiliary battery automatically.
- Considerably less expensive than commercially available products.
- Supplied with components, hardware, PCB, sealed diecast box and front panel label.

Cat K 3212 EA Jan '96 **$44.50**

Analogue Multimeter

- 19 Range Multimeter
- 90mm face scale
- Features transistor check, mirrored scale and continuity
- Power source required: 1 x 9v battery, 2 x 'AA' batteries
- 20K volt sensitivity
- Measures DC volts, AC volts, DC current and resistance
- Supplied with all components, hardware, PCB, comprehensive instructions,deluxe multimeter case and test leads.

Cat K 1050

$29.60

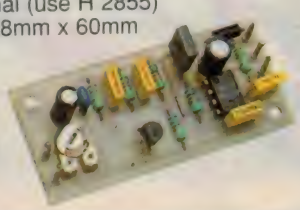
Silicon Chip Feb '97

Neon Tube Modulator

- Now you can wire the sound system of your car to the neon light system.
- Modulates 12 volt neon tubes.
- Connects to the subwoofer feed so the tubes oscillate with the bass beat.
- Comes with sensitivity adjustment.
- Power source required: 12 volts DC.
- Supplied with components and PCB. Optional neon tubes available from various lighting shops. Further details inside instructions.
- Case optional (use H 2855)
- PCB size: 28mm x 60mm

Cat K 3164

$7.95



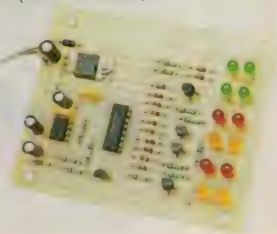
Silicon Chip May '97

Traffic Light Simulator

- Simulates a set of traffic lights at a cross intersection
- Circuit designed as a free-running oscillator cycling lights through the green, amber and red sequence
- Power source required: 15 volts DC
- Supplied with components, LEDs and PCB
- Case optional (use H 2851)
- PCB size: 80mm x 95mm

Cat K 3023

$14.95



Silicon Chip May '97

Availability: Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied as to their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however if you'd like to check beforehand, please don't hesitate to contact your local store.

Construction Project:

ADD-ON REGULATOR FOR 12V BATTERY CHARGERS

This simple project turns a 'bare bones' automotive battery charger into a fully regulated charger that can be left connected to a battery indefinitely. It uses readily available components such as a 555 timer, and the circuit board containing the regulator can be built into most low cost chargers. It has been designed to adapt an Arlec 4 charger, which is available from most supermarkets.

by HEINZ P. HARLE

Lead-acid battery chargers come in all shapes and sizes, but perhaps the most popular are the basic chargers available from a supermarket. Most of us need to charge a car battery now and again, usually when you least expect it.

As well, it's good practice to keep a lead-acid battery topped up, as discharging it below about 80% of its capacity can shorten its life, (unless it's specially designed for heavy discharge).

A typical low cost automotive battery charger generally has a charge current capability of between four and eight amps. When using it to charge a battery, you have to monitor the charge state of the battery and disconnect it from the charger when it's fully charged. Otherwise the battery will overcharge, and possibly lose electrolyte or even sustain damage.

To keep a battery topped up, you could use a timer to switch a basic charger on for several hours every few days. However this is not a reliable method as it doesn't take into account the charge level of the battery.

A better way is a simple add-on regulator circuit so the charger can be left connected to a battery continuously; which is what this project does. It works on the principle that once the battery reaches a predetermined voltage, the charger is switched on and off to maintain that value indefinitely. But surprisingly, such an add-on circuit is not as easy as it might first appear.

Upgrade your basic charger by adding this simple regulator. It lets you leave a battery on charge as long as you like, without risk of overcharging.

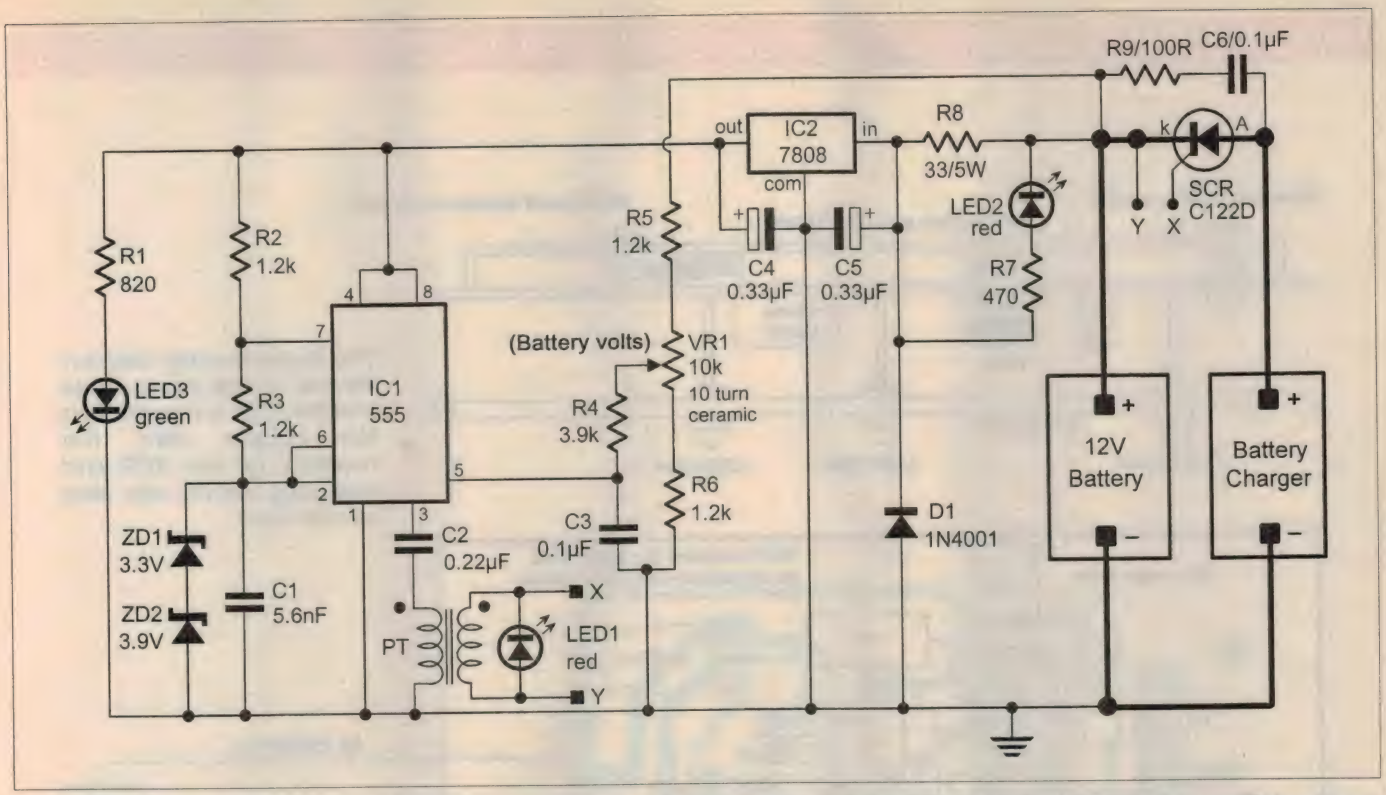
Development process

In my search for information, I looked through a range of electronics magazines, but to no avail. Certainly there were charger circuits, some using a switch-mode regulator and others based around a series regulator, but I found none that I could simply add to a basic charger.

I then remembered that around 20 years ago, I built a simple charger based on a Motorola application note. This circuit (see Fig.1) had a UJT (unijunction transistor) relaxation oscillator triggering an SCR. While the battery voltage is less than a preset value, the UJT oscillator produces trigger pulses to trigger the SCR, allowing charge current to flow. Because the output of the charger is a series of positive half-cycles of the AC supply voltage (unfiltered DC), the SCR turns off at the end of each half-cycle of the input.

When the battery voltage reaches a preset value (normally 13.8V to 14V for a 12V battery), the oscillator stops running and the SCR is held off. The battery voltage will fall slightly, to a point where the oscillator starts, and charge current flows, causing the battery voltage to increase. The circuit now cycles between its off and on states, keeping the battery voltage constant at the preset value.

But technology has moved on, and it's now difficult to buy a UJT. I decided to try a PUT (programmable unijunction transistor) in place of the UJT, as its operation is rather similar. However, in a UJT circuit the timing resistor (R1) can be a relatively low value, allowing a comparatively large value of timing capacitance (C1). This is important as the timing capacitor also supplies the energy to the pulse transformer that trig-



The 555 astable oscillator provides trigger pulses to the SCR. When the battery is fully charged, the oscillator stops, keeping the SCR turned off. When the battery voltage falls slightly, the oscillator starts again. The circuit cycles between these two states, keping the battery voltage at the value set by VR1.

gers the SCR. A PUT oscillator circuit needs a higher value of timing resistance, and a subsequently lower value of timing capacitance for the same operating frequency.

This means there's not enough energy in the capacitor to reliably trigger the SCR. Changing the values to get reliable triggering gives an operating frequency that is too low, causing triggering to occur later in the cycle, therefore giving less charge current. There's also a possibility of RFI (radio frequency interference) being generated, caused by the SCR switching on after the input voltage has passed through its zero point. So it was back to the drawing board!

I then decided to try a 555 timer as the oscillator, as apart from being readily available, the timing components would be independent of the triggering components.

The circuit

The final circuit is as shown, and has a similar operation to the original Motorola UJT regulator. The 555 timer is configured to run as an astable oscillator, with the advantage that it can operate at a higher frequency than that possible with either a UJT or PUT circuit. The battery voltage is sampled by the network of R4-6, C3 and VR1, and a fraction of this voltage (set by VR1) is applied to the modulating input terminal (pin 5) of the 555. When the voltage at this pin reaches the preset value, the oscillator stops, and the charger cycles between its off and on states, as for the UJT oscillator described before.

This arrangement allows the voltage at which charging stops to be set to within a few millivolts of the required value, typically around 14 volts at 25°C. Because the oscillator is running at about 40kHz, there's very little RFI, as the SCR is always triggered close to the zero point of the input voltage. Remember, the input voltage to the circuit is unfiltered DC, so it varies from zero to its maximum value every 10ms.

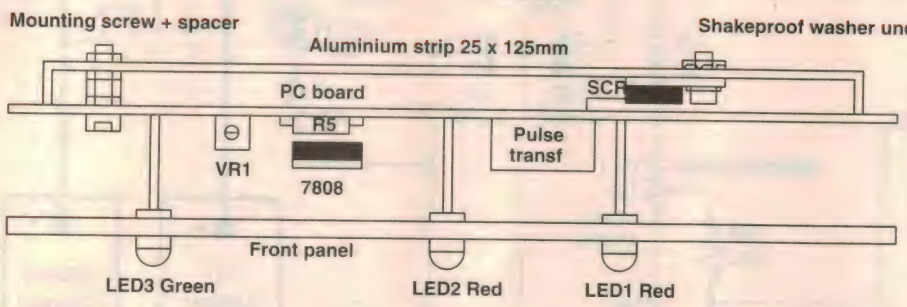
Zener diodes ZD1-2 clamp the charging voltage across capacitor C1 in a similar way to that of the UJT circuit. Their purpose here is for temperature compensation, as the specified zener diodes have a negative temperature coefficient. Hence the use of series-connected 3.3V and 3.9V zeners rather than a single 7.2V zener, which has a positive temperature coefficient. This results in a regulated battery voltage of around 14V on a hot day, and up to 16V on a cold day. The voltage regulator for an automotive generator used to be set at 14.2 - 15V at 40°C and 15.6 - 16.4V at 1.67°C.

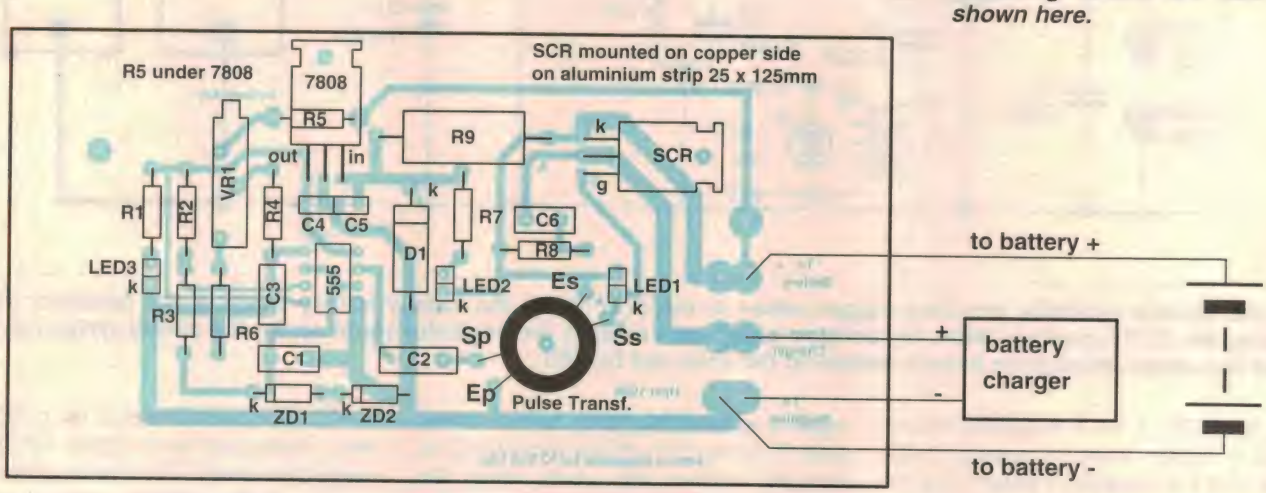
The output of the 555 feeds the primary of a pulse transformer, via capacitor C2. The transformer in the prototype was constructed on a 15mm OD powdered iron toroid. The windings are bifilar (i.e., both windings wound at the same time), with about 20 turns of 0.25mm enamelled wire. Wire-wrap wire is ideal as it comes in various colours. You will need about one metre. I initially used a commercial pulse transformer, but these are too expensive and possibly difficult to obtain. (Farnell and RS Components have them at around $10 each.)

LED1 (a high efficiency LED) is connected in parallel with the secondary of the pulse transformer, and indicates that the 555 is operating. It lights when the output pulse goes negative and the SCR is triggered when the pulse is going positive. Capacitor C2 prevents the DC component of the output from saturating the core of the pulse transformer.

For the circuit to work, the charger leads must be connected correctly (right polarity), and the battery must not be completely flat. This is usually the case for most serviceable batteries, as they maintain a voltage of around 10 to 12V under no load. If the voltage is below this, it's probable that the battery has reached the end of its useful life.

Because the regulator circuit is powered by the battery and not the charger, if you short the leads together (before





The layout/overlay diagram for the circuit board. Note that the SCR is mounted on the copper side. the heatsink for the SCR and mounting details are also shown here.

they're connected to the battery), no current will flow, as there's no supply voltage for the circuit, and hence no trigger pulses to the SCR. This means that the circuit is short circuit proof.

The three-terminal regulator (IC2) provides a regulated voltage of 8V for the regulator circuit, and prevents damage to the 555 when the battery or supply voltage is 16 volts or more. Diode D1 and resistor R8 protect the circuit if the battery is connected with reverse polarity. Under these conditions, LED2 lights as a warning.

Correct battery connection is indicated by LED3 (green) glowing. LED1 varies in intensity depending on the battery's state of charge. This LED is brighter when the battery is discharged, and pulses slightly when the battery is at full charge. Resistor R9 and capacitor C6 form a snubber network to reduce the possibility of 'rate effect turn on' which occurs when a rapid voltage change is applied across the SCR.

A closeup of the component side of the PCB. The regulator is bent over to conserve inside the space.

Construction

The prototype was constructed on a 100 x 50mm piece of matrix board and then transferred to a printed circuit board. The artwork of the board is included in this article. I mounted the board behind the front cover of an 'Arlec 4' 12V battery charger, which I purchased from a supermarket for around $35. The construction diagrams shown are for this charger.

Most chargers, like the Arlec, have a double insulated, centre-tapped trans-

former, two diodes and a thermal cutout. Notice that there's no filter capacitor. Some also have several LEDs to show the state of the battery being charged, but this indication is often too rudimentary to be useful.

All components mount on the board, as shown in the layout diagram. Note that the SCR solders to the copper side of the board. The SCR needs a heatsink which is simply a strip of 16 gauge (1.25mm) aluminium measuring 125 x 25mm. The heatsink is held to the PCB with a single nut and bolt, separated from the PC board with a suitable spacer. If you bolt the SCR directly to the heatsink, the heatsink is 'live', so make sure it doesn't contact any other components in the charger.

Notice also that the 7808 voltage regulator is bent at right angles to the board. This means the regulator body is over resistor R5, but as the regulator doesn't produce much heat, this is not a problem. Mount resistor R9 a few millimetres above the board, to allow for its heat dissipation.

To wind the pulse transformer, cut two lengths of 0.25mm enamelled wire about 500mm long, and wind 20 turns of both wires around the toroid. The pads for soldering the start and end of each winding are marked on the layout diagram as Sp (start primary) and Ep (end primary), and Ss and Es (secondary). If a winding is reversed, the trigger pulse for the SCR will have the wrong polarity.

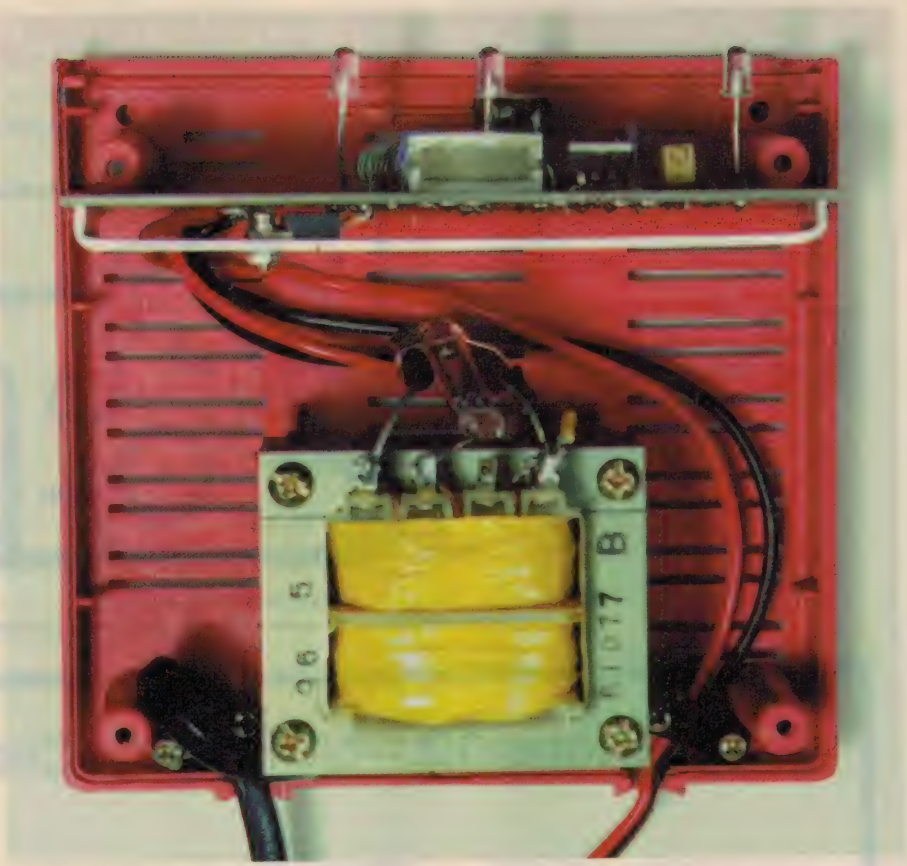
I used the original front panel of the charger as support for my own front panel. This required three holes, one for each LED, to be drilled in the panel. For the Arlec charger, there are slots in the case to support the front panel, and extra slots that can be used to support a PCB. This means mounting the LEDs around 16mm or so from the PCB, so they can project through the front panel.

If you build the regulator into the charger, simply cut the leads from the charger, and connect them to the board as shown in the layout diagram. This will shorten the leads by about 80mm.

Options

The regulator can also be mounted in a separate box and linked to the output of the charger. If you do this, drill ventilation holes in the case.

Or you might want to build your own basic charger for use with this regulator. You'll need a transformer with a centre-tapped secondary of 26V (or so), giving 13V RMS per side. The secondary should be rated at around 5A, and connects to two diodes that must also be rated at 5A. A centre-tapped rectifier circuit has less loss (and less heat dissipation) compared to a bridge circuit, as there's only two diodes.



As the photo shows, the heatsink for the SCR is the same length as the PCB, and is 'live', so keep it away from other exposed wiring. The photo also shows how everything fits inside an Arlec 4 Charger. You might need to trim the PCB to allow for the contour of the case.

While the charger being described here is rated at 4A, the regulator can handle more current if you use a suitably rated SCR. For a 15A charger, use a 20A rated SCR. These devices are more expensive than a 10A SCR, and are generally stud mounted. They are also often less sensitive than a lower

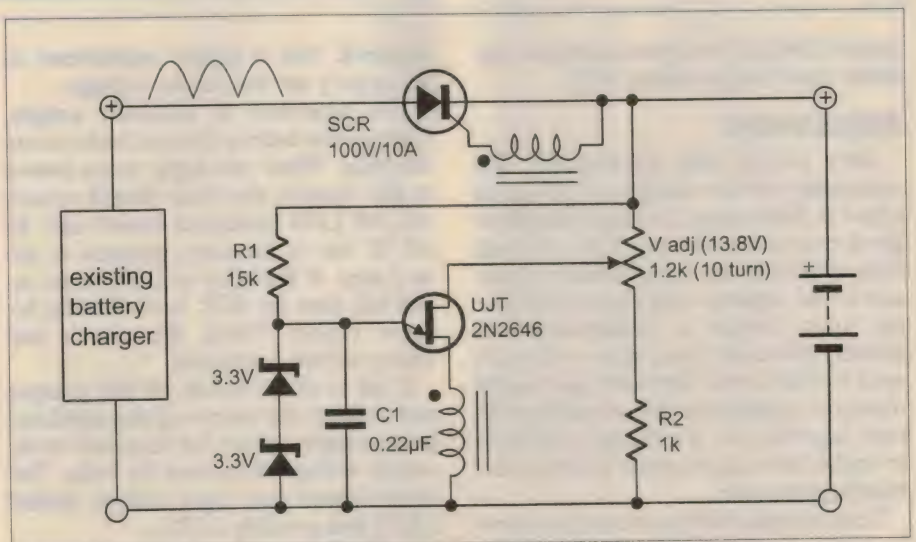
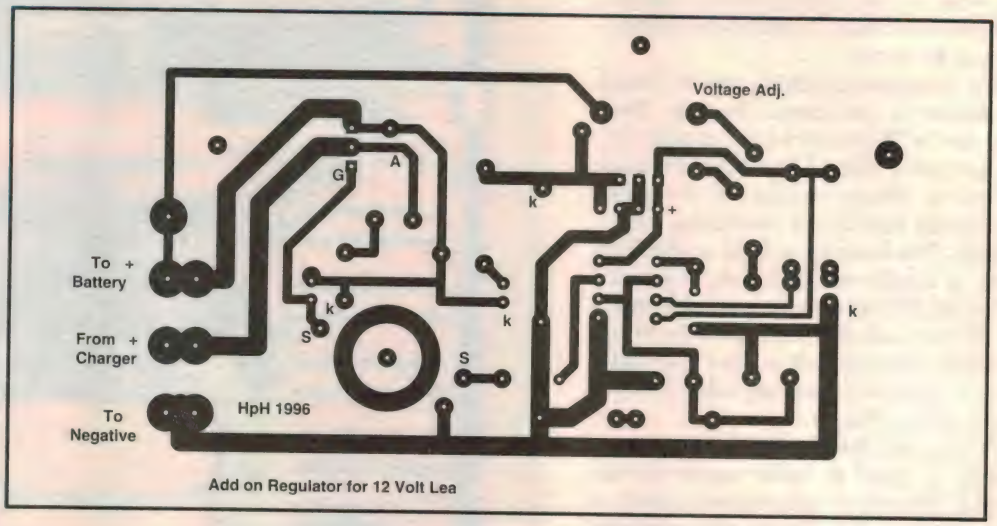
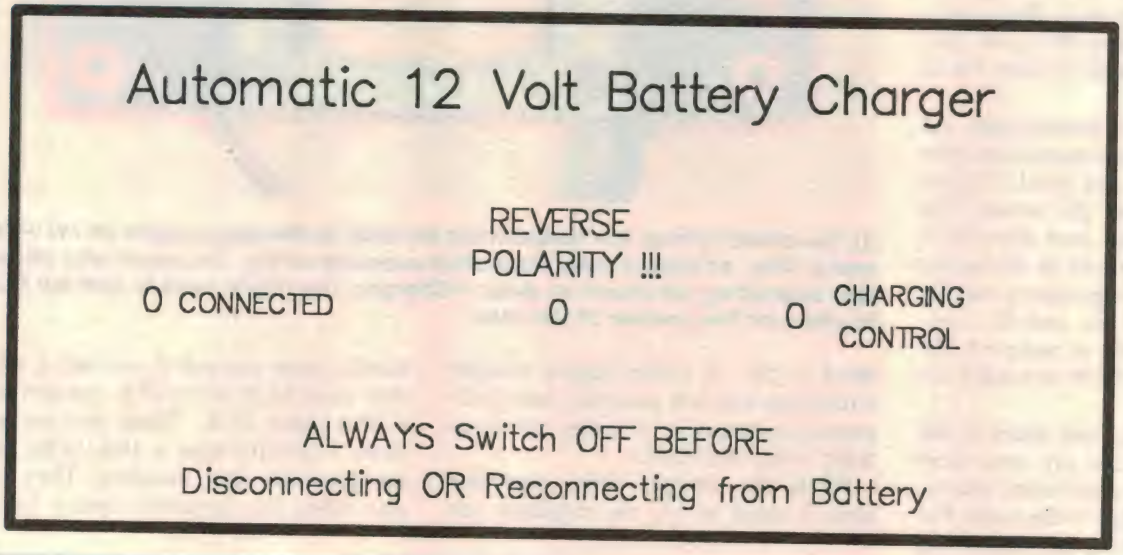


Fig.1: This simple regulator uses a UJT relaxation oscillator to trigger an SCR. When the battery voltage reaches a preset value, the oscillator and the charge current stops. The circuit then maintains this voltage.

Here's the artwork for the PC board, reproduced full size so you can make your own if you wish.





This artwork is for the replacement front panel of an Arlec 4 charger fitted with the regulator.

current device. I have not tested this regulator with a high current SCR.

Adjustment

Once you've built the regulator and connected it to the charger, it remains to adjust it. This means you must be able to get access to the trim pot VR1. A small hole drilled in the case directly above and in line with the trim pot is ideal. For the Arlec charger, a ventilation slot is directly above the trim pot so you won't need to drill a hole. Normally you would make the adjustments before putting the case together, but it's handy to be able to make later adjustments without dismantling the case.

Testing and calibration can be done by using an adjustable power supply with an output voltage variable between 10 to 18 volts. A 12 volt tail/stop lamp as a load is also required. Use a digital multimeter to accurately set the output voltage.

The procedure is relatively simple. Connect the battery charger leads across the lamp. When you apply mains power to the charger, the lamp should remain off. All LED indicators should also be off. If this is the case, proceed to the next step. If the lamp is lit or pulses on and off, then the SCR is conducting for some reason. Check the circuit and wiring before continuing.

If all is well, switch off the charger and connect the output of the regulated power supply across the lamp and set its output voltage to around 14 volts. The lamp should now light and so should LED3 and possibly LED1.

If LED2 lights, check the wiring, as it indicates reverse polarity to the regulator.

Now adjust the trim pot until LED1 just turns off. Verify this by varying the power supply voltage by a small amount either side of 14 volts. As the supply voltage drops below 14 volts, LED1 should light up brightly. When the voltage is slightly above 14 volts, it should go out completely. This should occur for a very small change in the power supply voltage, possibly a few millivolts. Once this value is found, adjusting the trim pot by one or two turns either way should turn LED1 on or off. If you need more turns check the circuit.

If everything is working as described, apply power to the battery charger, and watch the test lamp. You should find that when the power supply voltage is increased to slightly above 14 volts, LED1 should be off and the lamp brightness should decrease by a noticeable amount, as the SCR will be off. The reverse applies when the power supply voltage is below 14 volts. That is, LED1

is on, and the lamp glows more brightly.

If you use an oscilloscope to look at the current from the charger, you'll find that when a battery is fully charged, the charger applies charging pulses at random. These can vary from several (rectified) full wave cycles to one or two cycles every second or so. This might cause an erratic reading on an ammeter, but is quite normal.

Using the charger

There are several things to be aware of when charging any lead-acid battery. The most important is to realise that a lead-acid battery generates explosive gases that can be ignited by a spark, cigarette or naked flame. Make sure the battery is in a well ventilated area while it's being charged.

Another safety aspect to watch is the possibility of a short circuit across the battery terminals. Apart from generating sparks (which can ignite the surrounding gases), a short across a typical car battery can cause considerable damage to the battery or the object (like a screwdriver) that is causing the short.

Because the charger is supplied from the mains, don't expose it to rain or water. Also, take care when handling the electrolyte of a lead-acid battery. The electrolyte is sulphuric acid, which will quickly burn holes in clothing. If you accidentally spill electrolyte on yourself, flush it away immediately with large amounts of cold water.

In case of accidental eye contact with battery acid, flush your eyes for at least five minutes with clean water. Your eyes should be submerged under water and kept open while you do this. You should also see a doctor as quickly as possible. Don't use eye drops or other medication unless instructed by a doctor.

Having read the safety precautions, and wearing wrap-around safety goggles, it's time to attach the charger to a car battery and verify that it works properly. Ideally the battery should be removed from the vehicle.

Make sure the charger is disconnected from the mains supply (to avoid sparks that could ignite gases from the battery), then connect the charger leads across the battery terminals. LEDs 1 and 3 should light. If so, connect the charger to the mains and switch on. Monitor the battery voltage and observe that it slowly rises to around 14 volts. At this point LED1 should decrease in brightness and possibly flash randomly at several pulses per second. The time taken depends on the battery's charge state, so it could take several hours to reach full charge.

If you are using a commercial unit as your basic charger, its internal thermal cutout might operate if the battery is discharged. This is not a problem as the cutout will reset itself. Its purpose is to prevent damage to the charger caused by a high charge current.

If you have a battery with removable vent plugs, you should remove these and check that the battery does not produce excessive bubbling while charging. If some cells do this, it's possible the battery is faulty, as most batteries don't produce a lot of bubbling during charging. A typical lead-acid battery should last for around four to five years. In that period you could have to top up the electrolyte once or twice, more often is usually abnormal.

There are many reasons why the electrolyte level in a battery drops. One reason is that the engine could be idling too slowly, causing the battery to cycle between high discharge and recharge currents. A heavy electrical load, slipping alternator drive belt, low alternator output current or high output voltage are other reasons. A continually high ambient temperature around the battery caused by insufficient air flow can also cause premature loss of the electrolyte.

Finally, if you have any comments about this project, I can be reached on the EA BBS (02) 9353 0627, the Mt Druitt TAFE BBS on (02) 9839 1310 or on any BBS subscribing to FidoNet at address 3:713/709. ❖

PARTS LIST

Resistors

All resistors 1/4W, except R8

R1	820 ohm
R2,3,5,6	1.2k
R4	3.9k
R7	470 ohm
R8	33 ohm 5W
R9	100 ohm
VR1	10k, 10 turn ceramic trim pot (DSE cat R-1901)

Capacitors

C1	5.6nF polyester
C2	0.22uF polyester
C3,6	0.1uF monolithic
C4,5	0.33uF tantalum

Semiconductors

IC1	555 timer
IC2	7808 8V regulator
ZD1	1N746 3.3V 400mW zener*
ZD2	1N748 3.9V 400mW zener*
LED1,2	Red high intensity LED
LED3	Green high intensity LED
D1	1N4001 1A diode
SCR	C122D SCR, 8A 400V

* can also be two 3.6V zeners 1N747

Miscellaneous

15mm OD iron powder toroid core (DSE cat R-5410 or similar); 1m x 0.25mm enamelled copper wire (or wire-wrap wire of similar size and two different colours); PCB 130 x 65mm; basic 12V lead-acid battery charger as described; screws; solder etc.

Construction Project:

LASER LINK COMMUNICATOR

There's something rather futuristic about talking 'over' a laser beam, which is what this inexpensive project allows. It will easily give a communication distance of several hundred metres, and with a parabolic light reflector, up to several kilometres. It transmits high quality audio and the link is virtually impossible for anyone else to tap into.

by PETER PHILLIPS

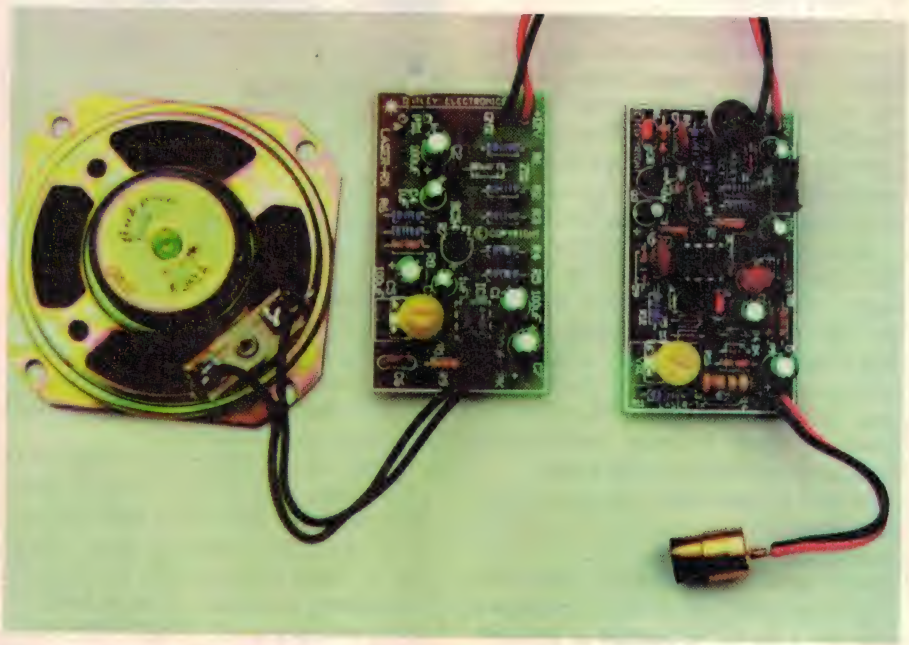
In the February 1993 issue, we described a laser beam communicator project developed by Oatley Electronics. It was an extremely popular project, but this latest version not only makes the device better and simpler, but cheaper as well. Unlike the previous version, a visible laser diode (5mW 650nm) is used as the transmitter. This makes alignment between the transmitter and receiver much simpler, as you can now see the beam. As well, the laser has a greater output power. The circuitry is also simpler, and uses basic components.

As before, there are two sections: the transmitter board and the receiver board, both powered by a separate 9V battery or a fixed voltage power supply, depending on your needs. The transmitter board has an electret microphone module at one end, and the laser diode at the other end. The electronics modulates the intensity of the laser beam according to the output of the microphone. The laser diode has an inbuilt collimating lens, and is simply a module that connects to the transmitter board. The previous design required brackets for the laser diode assembly.

The receiver uses a photodiode as the receiving element, and the on-board amplifier powers a small 4-36 ohm speaker. This board is therefore a high gain amplifier with a basic audio output stage.

But what about results — are they better? Sure. Because this design uses a higher power (and visible) laser beam, the range is improved, and alignment is easier and not all that critical, especially over a few hundred metres. The quality of sound transmitted by the link is quite surprising.

As a simple test, we set up the prototype with the transmitter microphone near a radio. The received sound was clear and seemed to cover the full audio bandwidth. We haven't tried feeding an audio signal directly to the transmitter, but that will undoubtedly give even better results.



This project lets you transmit audio information with complete security over a laser beam. For very short-range demonstration purposes, the laser diode can be replaced with a LED.

So clearly, this project is ideal for setting up a speech channel between two areas, say adjacent houses, or offices on opposite sides of the street. Or you could use it as a link between the workshop and the house. For duplex (two way) communication, you'll obviously need two laser 'channels'.

An important feature of transmission by laser beam is privacy. Because a laser beam is intentionally narrow, it's virtually impossible for someone to tap into the link without you knowing. If someone intercepts the beam, the link is broken — signalling the interception. Fibre-optic cables also have high security, as it's very difficult to splice into the cable without breaking the link. However it's theoretically possible; so for the highest security, you probably can't beat a line-of-sight laser beam.

You can also use an infrared laser, as in the previous project. While this gives even better security, as you can't see the laser beam without special IR sensitive equipment, it also makes alignment more difficult. (An IR laser diode is available for the project; see end of article for details.)

Where the transmission distance is no more than metre of so, a LED (or two for increased power) can be substituted for the laser diode. For instance, where

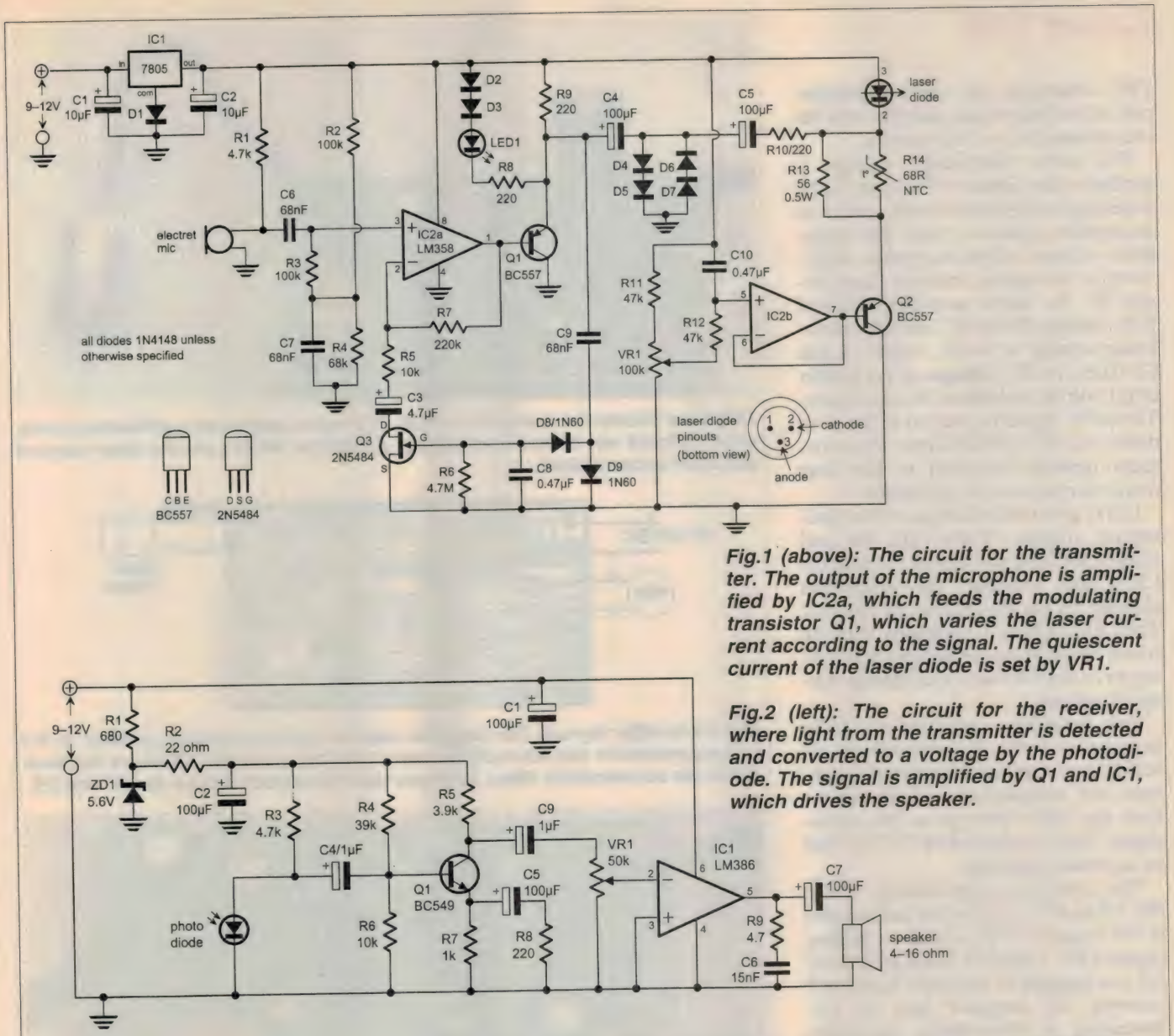


Fig.1 (above): The circuit for the transmitter. The output of the microphone is amplified by IC2a, which feeds the modulating transistor Q1, which varies the laser current according to the signal. The quiescent current of the laser diode is set by VR1.

Fig.2 (left): The circuit for the receiver, where light from the transmitter is detected and converted to a voltage by the photodiode. The signal is amplified by Q1 and IC1, which drives the speaker.

the link is being used for educational purposes, such as demonstrating fibre-optic coupling, or the concept of communication over a light beam. Obviously the security of the transmission is much lower as LEDs transmit light in all directions.

While this laser link can be adapted for use as a perimeter protector (as in the previous version), Oatley Electronics has developed a project especially for this purpose. Contact Oatley Electronics for further details if that is what you are really after.

Now to a description of how it all works. As you'll see, it's really very simple. We'll start with the transmitter...

Transmitter

A laser diode needs a certain value of current, called the *threshold* current, before it emits laser light. A further increase in this current produces a greater light output. The relationship between output power and current in a laser diode is very linear, once the current is above the threshold, giving a low distortion when the beam is amplitude modulated.

For example, the 650nm 5mW laser diode used in this project has a typical threshold current of 30mA and produces its full output when the current is raised by approximately 10mA above the threshold to 40mA. Further increasing the current will greatly reduce the life of the laser diode, and exceeding the absolute maximum of 80mA will destroy it instantly. Laser diodes are very fragile and will not survive electrostatic discharges and momentary surges! However, if used within specifications, the typical life of one of these lasers is around 20,000 hours.

In the transmitter circuit (Fig.1) the laser diode is supplied via an adjustable constant-current source. Since the lasing threshold also varies with temperature, a 68Ω NTC thermistor is included to compensate for changes in ambient temperature. Note that the metal housing for the laser diode and the lens also acts as a heatsink. The laser diode should not be powered without the metal housing in place.

The quiescent laser diode current is controlled by Q2, in turn driven by the buffer stage of IC2b. The DC voltage as set by VR2 appears at the base of Q2, which determines the current through the transistor and therefore the laser diode. Increasing the voltage at VR1 reduces the laser current. The setting of

VR1 determines the quiescent brightness of the laser beam, and therefore the overall sensitivity of the system.

The audio modulation voltage is applied to the cathode of the laser diode, which varies the laser current around its set point by around +/-3mA. The modulation voltage is from the emitter of Q1, which is an emitter follower stage driven by the audio amplifier stage of IC2a. Diodes D4 to D7 limit the modulating voltage to +/-2V, while C4 and C5 block the DC voltages at the emitter of Q1 and the cathode of the laser diode. The audio signal is coupled to the laser diode via R10, which limits the maximum possible variation in the laser diode current to a few milliamps.

LED1 gives an indication of the modulating voltage. Diodes D2, D3 and resistor R8 limit the current through the LED and enhance the brightness changes so the modulation is obvious. The LED flickers in sympathy with the sound received by the microphone, giving an indication that a modulating voltage is present.

The inverting amplifier of IC2a includes a form of compression, in which the output level is relatively constant and independent of how soft or loud the audio level is at the microphone. This is achieved by FET Q3 and its associated circuitry.

The cascaded voltage doubler of C9, D8, D9 and C8 rectifies the audio signal at the emitter of Q1, and the resulting negative DC voltage is fed to the gate of Q3. An increase in the audio signal will increase the negative bias to Q3, increasing its drain-source resistance. Because the gain of IC2a is determined by R7 and the series resistance of R5 and Q3, increasing the effective resistance of Q3 will lower the gain.

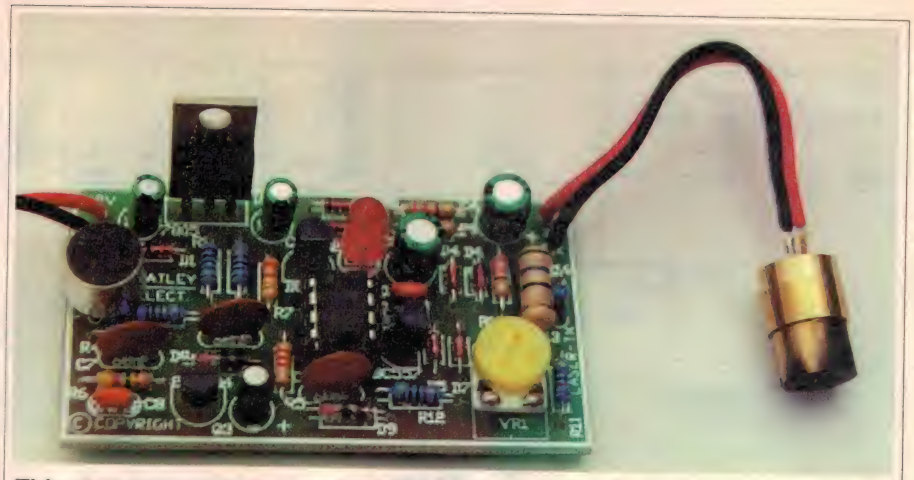
Since the compression circuit takes time to respond, the clamping network of D4-D7 is still needed to protect against sudden voltage increases. This system is rather similar to the compression used in portable tape recorders.

The electret microphone is powered through R1 and is coupled to the non-inverting input of IC2a via C6. This input is held at a fixed DC voltage to give a DC output to bias Q1.

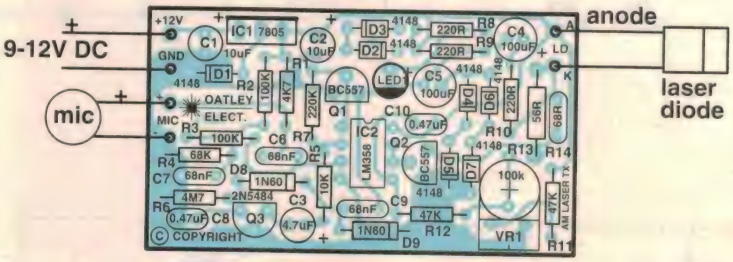
The supply voltage to the transmitter circuit is regulated by IC1, a 5V three terminal regulator.

Receiver

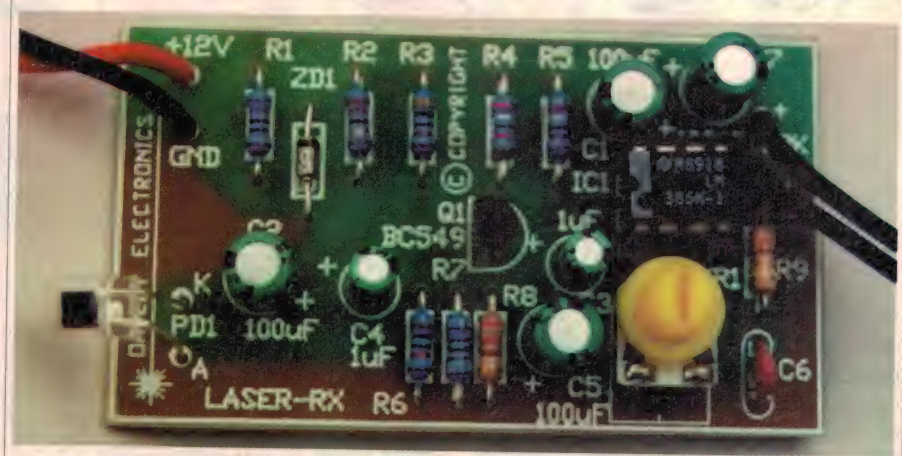
The transmitted signal is picked up by the photo detector diode in the receiver



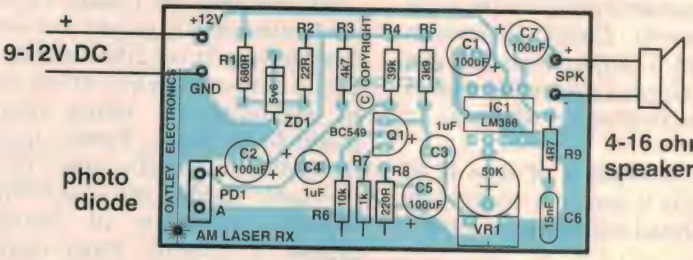
This shot shows the transmitter PCB. The laser diode has a collimating lens, which should not be removed during operation. Make sure the laser current does not exceed 40mA.



The transmitter layout. The negative lead of the microphone element is the one connected to the microphone case. See the circuit for details of the laser diode pin connections. Make sure you use the correct diodes for D8 and D9.



Here's a close-up of the receiver PCB in the prototype. Notice that the photodiode is bent over so its active surface faces away from the board.



The layout of the receiver PCB is shown here. Make sure you connect photodiode PD1 correctly.

(shown in Fig.2). The output voltage of this diode is amplified by the common emitter amplifier around Q1. This amplifier has a gain of 20 or so, and connects via VR1 to IC1, an LM386 basic power amplifier IC with a gain internally set to 20.

This IC can drive a speaker with a resistance as low as four ohms, and has an output power of around 350mW when the circuit is powered from a 9V supply. Increasing the supply voltage will increase the output power marginally.

The voltage to the transistor amplifier stage is regulated by ZD1 to 5.6V, and decoupled from the main supply by R2 and C2. Resistor R3 supplies forward current for the photodiode. (Incidentally, the photodiode used for this project has a special clear package, so it responds to visible light, and not just infrared.)

Construction

As the photos show, both the transmitter and the receiver are built on silk-screened PCBs. As usual fit the resistors, pots and capacitors first, taking care with the polarity of the electrolytics. IC sockets are not essential, although servicing is obviously made easier if they are used. In which case, fit these next, followed by the transistors, diodes and the LED.

Take care to use the right diodes for D8 and D9. These are larger than the 1N4148 types, and have two black bands (the cathode end) around a glass package. Note that the regulator IC has the tab facing outwards.

The photodiode is mounted directly on the receiver PCB. When first mounted, the active side of the diode (black square inside the package) will face towards the centre of the board. You then bend the diode over by almost 180° so the active surface now faces outwards.

The polarised microphone element solders directly to the transmitter PCB. The negative lead is marked with a minus sign and is the lead that connects to the metal case.

The laser diode is also polarised, and has three leads. Of these, only two are used, shown on the circuit as pins 2 (cathode) and 3 (anode). Take care when soldering the laser in place, as too much heat can destroy it. The diode can be mounted on the board, or connected with leads to it.

Finally, connect the speaker and 9V battery clips, then check over the boards for any soldering errors or incorrectly installed components.

Testing

First of all, it's most important that you don't look directly into the laser beam. If you do, it could cause permanent eye damage. Also, you are responsible for the safety of others near the laser, which means you must stop others from also looking into the beam, and take all necessary safety steps. This is covered by legislation.

Both the receiver and the transmitter can be powered by separate 9V batteries or suitable DC supplies. Before applying power to the transmitter PCB, set VR1 to its halfway position, to make sure the laser current is not excessive. To be totally sure, you could set VR1 fully anticlockwise, as this setting will reduce the laser current to zero.

Then apply power to the board. If the laser doesn't produce light, slowly adjust VR1 clockwise. The laser diode should emit a beam with an intensity adjustable with VR1. At this stage, keep the beam intensity low, but high enough to clearly see. If you are not getting an output, check the circuit around IC2b.

You should also find that LED1 flickers if you run your finger over the microphone. If so, it indicates that the amplifier section is working and that there's a modulation voltage to the laser diode. You won't see the laser beam intensity change with the modulating signal.

To check that the system is working, place the two PCBs on the workbench, spaced a metre or so apart. You might need to put a sheet of paper about 20mm in front of the photodiode to reduce the intensity of light from the laser beam. Set the volume control of the speaker to about halfway. If the volume control setting is too high you'll get acoustic feedback.

Move the laser diode assembly so the beam points at the receiver's photodiode. It's useful to adjust the beam so it's out of focus at the photodiode, to make alignment even easier. You should now be able to hear the speaker reproducing any audio signal picked up by the microphone. When the receiver and transmitter are in close range, the strength of the beam can cause the receiver to respond even if the laser beam is not falling on the photodiode.

Setting up a link

Once you've tested the link, you'll probably be keen to put it to use. For a short link of say 100 metres, all you need do is position the receiver so the laser beam falls on the photodiode. Once the link is established, adjust VR1

PARTS LIST

Transmitter:

Resistors

All 1/4W, 5% unless otherwise stated:

R1	4.7k
R2,3	100k
R4	68k
R5	10k
R6	4.7M
R7	220k
R8-10	220 ohm
R11,12	47k
R13	56 ohm 1/2W
R14	68 ohm NTC thermistor
VR1	100k trimpot

Capacitors

C1,2	10uF 16V electrolytic
C3	4.7uF 16V electrolytic
C4,5	100uF 16V electrolytic
C6,7,9	68nF ceramic
C8,10	0.47uF monolithic ceramic

Semiconductors

LED1	5mm green LED
Laser	5mW/650nm laser diode (or LED)
Q1,2	BC557 PNP
Q3	2N5484 N-ch JFET
D1-7	1N4148 signal diode
D8,9	1N60 germanium diode
IC1	7805 5V regulator
IC2	LM358 op-amp

Miscellaneous

PCB 65mm x 36mm; electret microphone element; 8-pin IC socket; 9V battery and battery clip.

Receiver:

Resistors

All 1/4W, 5% unless otherwise stated:

R1	680 ohm
R2	22 ohm
R3	4.7k
R4	39k
R5	3.9k
R6	10k
R7	1k
R8	220 ohm
R9	4.7 ohm
VR1	50k trimpot

Capacitors

C1,2,5,7	100uF 16V electrolytic
C3,4	1uF 16V electrolytic
C6	15nF polyester

Semiconductors

Q1	BC549 NPN
IC1	LM386 power amp
ZD1	5.6V 400mW zener

Miscellaneous

PCB 36mm x 64m; photodiode with clear casing; 9V battery and battery clip, 4-16 ohm speaker; 8-pin IC socket.

A kit of parts for this project is available from:
Oatley Electronics
Phone (02) 9584 3563
Postal address (mail orders):
PO Box 89, Oatley NSW 2223.
Prices:
Both PCBs, all on-board components, photodiode, speaker, battery clips and high intensity LED $29.
5mW/650nm visible laser diode and housing $30.
IR laser diode and housing $20.
Packing and postage charges $6.

Laser link communicator

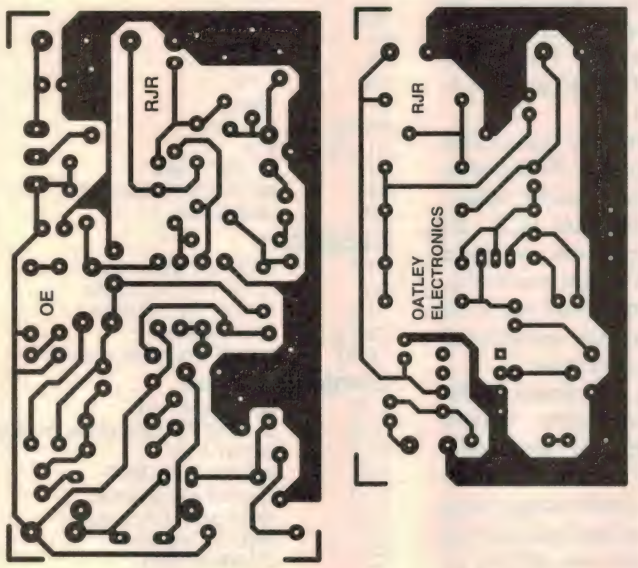
on the transmitter board to give the lowest quiescent laser current for good communications. Remember, the higher the laser current, the shorter will be its life.

If you have an ammeter, connect it to measure the current taken by the transmitter board. Most of the current is taken by the laser, so adjust VR1 to give a total current consumption of no more than 45mA.

Also, focus the laser so all of the beam is striking the photodiode. At close range, there's probably no need to focus the beam. In fact, because of the high output power (5mW) of the laser diode, excellent results will be obtained over reasonably short distances (20 metres or so) with rough focusing and quiescent current adjustments. But the longer the distance between the transmitter and the receiver, the more critical the adjustments.

For example, for distances over 20 metres, you might have to put a piece of tube over the front of the photodiode to limit the ambient light falling on it. This diode is responsive to visible light, so a high ambient light could cause it to saturate. For very long distances, say a kilometre, you'll probably need a parabolic reflector for the laser beam, to focus it directly onto the photodiode.

For short ranges (a metre or so), or for educational or testing purposes, you can use a conventional red LED. Adjust the quiescent current with VR1. The light output of a LED is not focused, and simply spreads everywhere, so a reflector might help the sensitivity.



The artwork for both PCBs, reproduced full scale for readers wanting to make their own. The design is copyright to Oatley Electronics.

Warnings

The laser diode in this project is a class 3B laser and you should attach a warning label to the transmitter. Labels will be supplied by Oatley Electronics.

Remember that, as for any hazardous device, the owner of a laser is responsible for its proper use. ❖

NEW BOOKS

Troubleshooting

TROUBLESHOOTING & REPAIRING AUDIO EQUIPMENT, by Homer L. Davidson. Published by McGraw-Hill, 1996. Hard cover, 190 x 240mm, 528 pages. ISBN 0-07-015755-3. RRP A$105.

The good thing about this book is that it deals with actual products, and doesn't rely on fictitious examples to show troubleshooting techniques. It is also a very practical book, based on the author's extensive experience. Although claimed to suit a beginner, it does require a basic knowledge of electronics, particularly in reading a circuit diagram.

There are 13 chapters, dealing with repairs on pocket-size cassette stereo players, compact stereo tape decks, 'boom-box' players, AM/FM/MPX tuners, hifi amplifiers, automotive cassette players, turntables, compact disc players (automotive and conventional), telephone answering machines, speakers and high power car radios. It does not cover video equipment or any other electronic equipment, other than basic measuring instruments.

Each chapter has numerous photos of actual products, although being a US publication, some of the equipment is unlikely to be found in Australia. A lot of the equipment is the Radio Shack (Tandy) brand. There are also various diagrams showing an exploded view of a piece of equipment, presumably from manufacturer's drawings.

Manufacturer's schematics are included, although these are scanned in from an original, making some difficult to read. A nice feature is the use of subheadings such as 'Will not eject cassette'. This means you can go to the chapter about the type of equipment you want to repair, look up a subheading that best describes the fault and get information.

The review copy came from McGraw-Hill, PO Box 239, Roseville 2069. (P.P.)

Filter circuits

UNDERSTAND ELECTRONIC FILTERS, by Owen Bishop. Published by Butterworth-Heinemann, 1996. Soft covers, 210 x 135mm, 198 pages. ISBN 0-7506-2628-3. RRP $45.

An introduction to the operation of filter circuits, written by prolific and well-known technical author Owen Bishop — now resident in Australia, and a regular contributor to *EA*. As he explains in his introduction, this one has been written to explain what filters are, how they work and how to use them, and provides only enough maths to achieve that end. Hopefully after reading the book, a reader will then have gained enough understanding to tackle more advanced texts with assurance. It assumes a minimum of electrical and electronics theory, and a level of maths at about high school level.

The first four chapters provide a lot of background material dealing with passive devices, electrical signals, reactance and impedance, and phase concepts. The remaining six chapters then deal with first and second-order passive filters, transfer functions and the s-domain, active filters, state-variable filters and finally digital filters. Each chapter includes 'Keeping Up?' and 'Test Yourself' questions, and the answers to these appear in two of the three data appendices at the rear. The third provides some handy filter design program listings, in GWBASIC.

The text is generally quite accessible, up to date and well supported by illustrations. On the whole, it would make an excellent primer on filters.

The review copy came from the author. (J.R.) ❖

Mini Construction Project:

LOW COST SMT SIX-SOUND MAKER

Here's another little project that is ideal for anyone wanting to get some 'hands on' practical experience with modern surface mount components and construction. Using only a handful of tiny parts, it's a low cost module which can produce any of six 'sound effects', when coupled to a 6V battery and a speaker. This should make it very suitable as a learn-while-you-build project for schools and TAFE colleges.

by JIM ROWE

Surface-mount technology (SMT) is steadily shrinking electronic components, and changing the way they're handled and the way they're used to build up circuits. Undoubtedly SMT is the future of electronics, and that means that we all need to get experience with it. Even though SMT parts are basically designed for automated assembly, there's still going to be a need for manual servicing. As SMT parts gradually replace conventional leaded components, we're also going to have to use them for building our 'one off' projects manually...

But how do you get experience with SMT, on a small scale and as an individual? Most SMT components are sold on large reels, intended to be loaded into the 'pick and place' machines which place them onto the PC boards before the automated soldering operation. Very few suppliers make surface-mount parts available in small quantities, for the hobbyist or individual technician.

That's where this little project comes in. It's been deliberately designed to give experience in manual handling and assembly of SMT components, and Lazer Installations, whose principal Anthony Moutopoulos developed the project, is also able to supply complete kits for it direct — at a very low price. This should make it very attractive as a 'learn while you build' project, for schools and TAFE colleges as well as individuals.

Apart from the battery (a standard 9V, 216-type) and speaker, all of the components fit on a tiny PC board measuring only 39 x 20mm. It's only slightly larger than a postage stamp.

The quoted price for each kit is only $8.00 plus $2.00 for packing and postage within Australia. This includes the speaker (but not the battery), and should be well within just about everyone's budget. Full details of the kit's availability are given in the parts list.

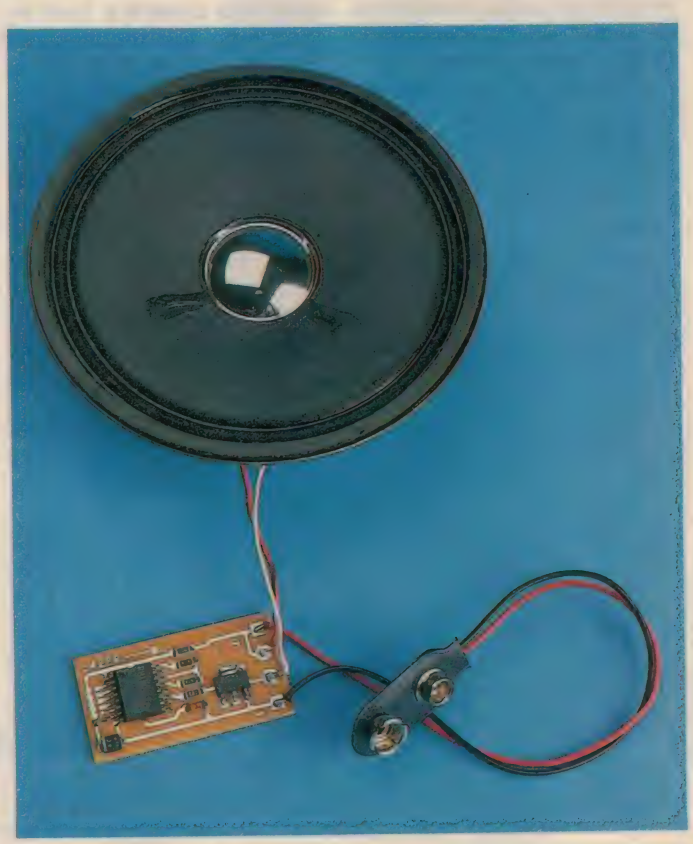
How it works

As you can see from the schematic, the circuit is especially simple because it's based on a dedicated 'sound synthesiser' chip, the AX3003 — also known as the 'Rhino 6S'. This is a special chip that was originally custom-designed for Rhino Alarms, a manufacturer of car security systems. Since the AX3003 chip does all of the real work, the rest of the circuitry can be very straightforward.

The AX3003 is a CMOS device which includes a clock oscillator and a ROM containing digital samples for six different sounds: a standard siren sound, a code alarm sound, a 'ray gun' sound, a 'slot machine' sound, a 'smoke alarm' sound and a 'Euro-siren' sound. There are two complementary outputs from the chip, which appear on pins 11 and 12.

The IC is powered from five volts, which is derived here from the 9V battery by a simple regulator circuit using series resistor R1 and 5.1V zener diode ZD1, with additional filtering by 4.7uF capacitor C1 (a solid tantalum type). The voltage for the IC therefore remains close to 5V despite changes in the battery voltage.

The oscillator circuitry inside the IC is enabled



An excellent project for gaining 'hands on' experience of surface-mount components — and the kit from Lazer Installations includes everything but the battery

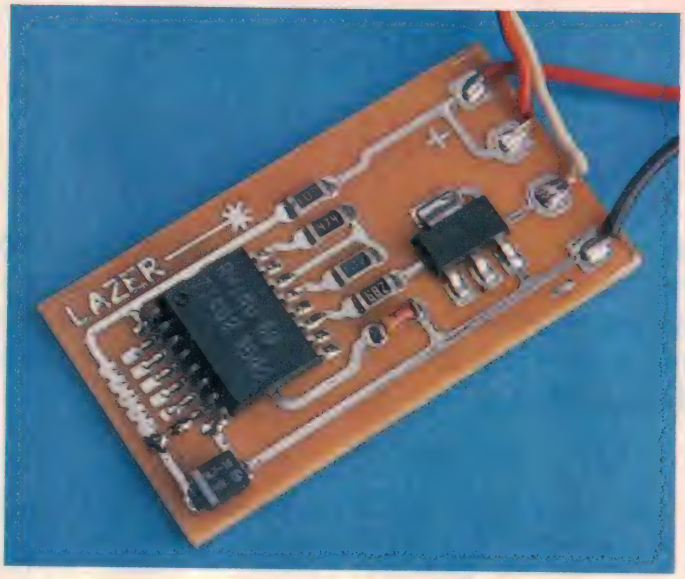
whenever any one of the pins 2 - 7 is joined to the positive rail. Each of these pins not only enables the oscillator, but programs a different sound. Hence we 'program' the module to automatically play any one of its repertoire of sounds, simply by linking the appropriate pin across to positive. This is done by means of one of the links A - F.

The actual oscillator inside the chip uses pins 16, 14 and 13, with its frequency determined by resistors R2 and R3.

As the output pins are not designed to drive a speaker directly, we use pin 11 here to drive Darlington power transistor Q1 via resistor R4. Q1 then drives the speaker, which can have an impedance between four and eight ohms. (The speaker included in the kit is of eight ohms.)

Note that there's no power switch; the unit is intended to be controlled by connecting or disconnecting the battery.

In terms of circuit operation, then, the project is very straightforward. The only difference is that in this case, all of the components we're using are in very small surface mount packages. The IC package measures only about 9.5mm long by 11mm wide (including 'gull-wing' leads), by about 2mm high — and that's the largest component by far. The Darlington transistor measures only about 6 x 7mm by 1mm high, and the tantalum capacitor (C1) 3 x 2.5 x 1.5mm. The resistors are in the '1206' SMD package, measuring a mere 3.0 x 1.5mm in area and less than 1mm high, and the zener diode is about the same size.



A closeup of the assembled PCB, nearly twice actual size. Visible at lower left are the links used to select the sound effect.

You will almost certainly need a magnifying glass or similar, to help you in building this project! Other handy tools to have available are a good pair of tweezers and a few toothpicks — along with a soldering iron fitted with a very fine pointed chisel bit (clean and well tinned), and of course some very fine-gauge resin core solder.

Construction

Firstly inspect the PCB board for any shorts or open circuits. Next make sure that you place all the components on a very clean clear area, so you can use the tweezers to pick and place them on the board as required.

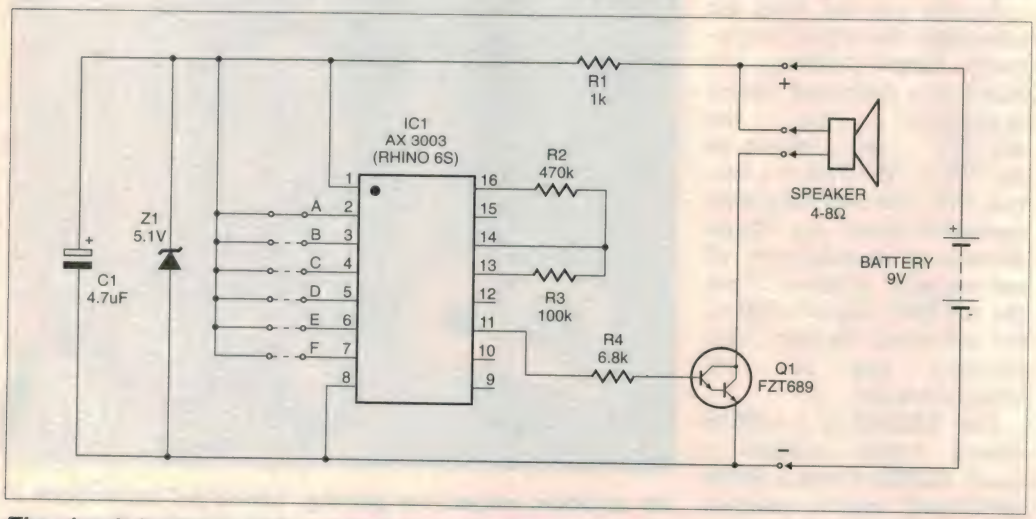
As an assembly hint, it is suggested that you use either 'BLU-TAK' or double sided sticky tape to anchor the PCB on the assembly surface, while you're adding the components.

Be very careful to identify the various components, because they're so small. The IC and Darlington transistor are quite easy to identify, with their larger packages and multiple pins. The zener diode is in a tiny cylindrical package, about 3mm long and a little over 1mm in diameter — but note that at one end, there's a small ring of yellow paint to identify the positive end. This is also the case with the tantalum capacitor C1, which like the zener must be installed the correct way around.

Note too that the IC package has a small dimple on the top near one end — very close to pin 1. This is the guide for orientating the IC correctly. The Darlington transistor has one 'fat' pin on one side and three smaller pins on the other, making its orientation easy to work out.

The PCB overlay diagram shows which way around C1, Z1, IC1 and Q1 are fitted to the board.

Since the resistors are all in the same '1206' packages, how can you tell them apart? It's easy when you know the coding used in their markings, which is basically the same as the colour code used for conventional leaded resistors, only in digits. Hence the 1k resistor (R1) is coded '102', the 6.8k resistor (R4) is coded '682' and so on. (See parts list).



The circuit for the sound maker is very simple, thanks to the functionality built into the AX 3003 chip — which contains digital samples of the various sound effects, in ROM.

The actual assembly

With the parts all identified, the next step is to fit them to the board. This is a bit fiddly, because SMT parts are really not intended for manual assembly. But if

you work carefully and follow the procedure to be described, it shouldn't present any problems.

Before attempting to solder each part to the board, pre-tin each of the corresponding board pads, using your fine-pointed iron and very fine gauge solder (definitely not the kind you use for soldering gutters!). This should leave a very thin 'cushion' of solder on each pad. Then move the component into position, with its ends or leads sitting on the pads, and hold it in place — using the end of a toothpick, or a fine pair of tweezers if you prefer. Finally, re-apply the tip of the soldering iron so that it contacts both one end of the component and its solder 'cushion', whereupon the solder should reflow and fuse the two together.

Initially, you only need to solder one end (the 'easy' end) of each of the smaller components in this way, to attach them to the board. The main thing is to ensure that the component doesn't move out of its correct position, or stand on end like a 'tombstone', while the solder is in the liquid state. Of course you should also prevent it from moving until the solder solidifies, to ensure a good joint. Don't exert too much pressure on the component, though — if it ends up stressed, it may very well fail.

This procedure should be followed with all of the smaller parts, and is only modified slightly for the IC. With the latter you can solder say pin 1 first, then check that all of the remaining pins are positioned squarely over their respective pads. Then you can solder pins 2-8 on the same side, if all seems OK. This will anchor the chip to the board quite firmly, allowing you to come back and solder the remaining pins after you've soldered the 'other ends' of the smaller parts.

Much the same applies for Q1. Here you can solder the fat collector pin first, and the three smaller pins later.

This 'one end of all parts first' approach has the advantage that you don't have to keep turning the PCB around all the time. It also ensures that each part can cool down from the first soldering, before it gets heated up again...

Perhaps we should stress again here that you should take great care to fit the polarised parts (the IC, transistor Q1, zener diode Z1 and tantalum capacitor C1) to the board with the correct orientation, BEFORE soldering even one end to the board. These parts can be *very* hard to remove again without damaging them, if you discover later that you've installed them the wrong way around.

Resoldering or 'reworking' of these SMT components is NOT recommended — so your motto should be 'MAKE SURE BEFORE YOU SOLDER'.

Take special care when you're soldering the IC pins, because the chip can easily be damaged if you leave the iron on too long and it's overheated. After soldering its pins (which are spaced at 0.05" — half the spacing of conventional DIP pins), examine them very closely with a magnifiying glass to ensure that you haven't left any solder bridges.

Finally, solder the red and black wires from the 9V battery snap connector to the PCB, with the red wire going to the '+' pad and the black wire to the '-' pad. Similar short lengths of wire can be used to connect the speaker to the two pads in between the battery connections.

PARTS LIST

(All components except speaker in SMD form.)

Resistors

R1	1k ('102')
R2	470k ('474')
R3	100k ('104')
R4	6.8k ('682')

Capacitors

C1	4.7uF 16VW tantalum ('4.7-16')

Semiconductors

Z1	5.1V zener (cylindrical glass body)
Q1	FZT689 NPN Darlington ('FZT689')
IC1	AX3003 IC ('RHINO 6S')

Miscellaneous

PCB, 39 x 20mm, RCS code 4508s; 90mm speaker, 8 ohms impedance; 9V battery snap connector with leads; 9V 216-type battery (not included in kit).

Note that complete kits (apart from the 9V battery) for this project are available from Lazer Installations, of PO Box 13, Little Bay 2036; phone (02) 9311 1500, or (018) 231 861. The cost is $8.00 per kit, plus $2.00 for packing and postage anywhere in Australia. Payment can be by cheque, cash or money order; however credit card orders can't be accepted.

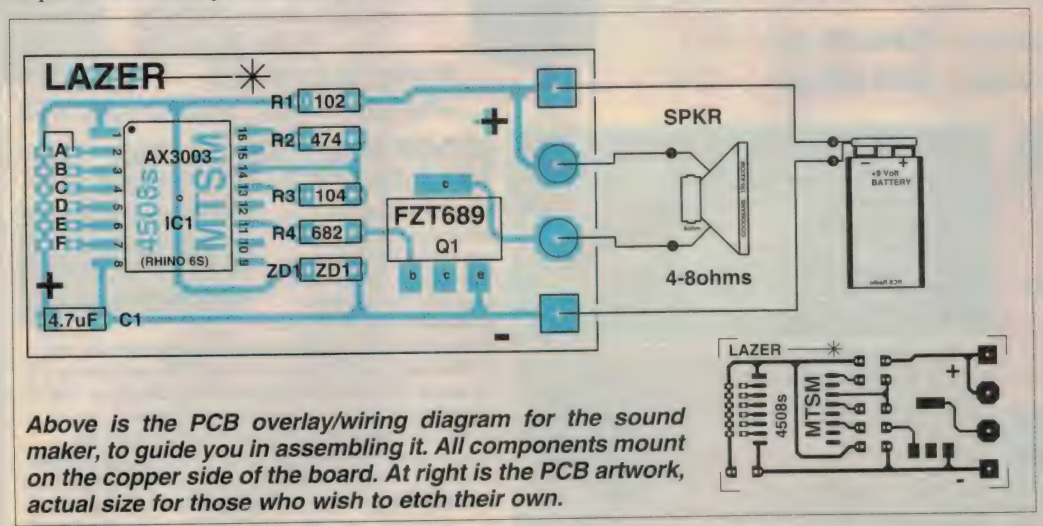
Trying it out

Your sound maker should now be complete, and it should only remain to fit a short wire link to the PCB in one of the six positions A - F, to select the sound you want. Then if you connect the battery to the snap lead, you should be rewarded by having the speaker emit the appropriate sound.

That's all there is to it. To try out the various sounds, it's merely a matter of disconnecting the battery, removing the selector link and refitting it in another position. Then connect the battery again, to hear the effect.

You can actually fit links in all six positions, in which case the chip will automatically cycle through the six sounds in turn, over and over. It's all good fun, and of course you're getting good experience with surface-mount technology at the same time...

By the way, kit supplier Lazer Installations is also able to supply SMT Starter Kits, containing 50 of each of 18 different SMT resistor or capacitor values (i.e., a total of 900 parts in each kit). The Resistor Starter Kit sells for $35, and the Capacitor Starter Kit for $85 — plus $3.00 in each case to cover packing and postage. The address information is shown in the parts list. ❖



Above is the PCB overlay/wiring diagram for the sound maker, to guide you in assembling it. All components mount on the copper side of the board. At right is the PCB artwork, actual size for those who wish to etch their own.

Jaycar ELECTRONICS

JULY BARGAINS

Prices valid until 31st July 1997

CCD BOARD CAMERA

This 1/3" black and white camera is so small, its simply amazing!! The PC board measures just 32 x 32mm and the camera protrudes from the board about 23mm. This camera allows mounting in extremely small places. To focus simply turn the lens, and the unit requires 12VDC +/-1V. If you are using an AC adaptor plug pack, use a regulated one, as too many volts or reverse polarity will damage the camera. It has a video output which can be connected to a monitor or video in, on your VCR or to a TV through a video modular.

Cat. QC-3460 **Only $139.50**

PANASONIC 1.9AH 12V SEALED LEAD ACID BATTERY

PANASONIC No. LC-TA121R9PU. Another surplus stock purchase. These are used in certain phones, or can be used as a standard SLA battery for burglar alarms, lights etc. Its very easy to solder leads to the battery terminals. Size 181(L) x 23(W) x 60(H)mm. To buy one of these as a replacement, it would cost arround $100. Cat. SB-2482

SAVE A FORTUNE!

Limited quantity **These are Only $20 ea**

Weller PORTASOL GAS SOLDERING IRON

Portasol returns!! Portable soldering. The Weller Portasol uses butane gas lighter fuel and is temperature adjustable (equivalent 10-60W). Fills in 20 seconds & has up to 90 mins continuous use fuel capacity. Supplied with cap. Use Jaycar gas - Cat. NA-1020 $5.95. Spare 2.4mm Tip - Cat. TS-1721 $19.95

Cat. TS-1720 **$49.95**

RED HOT POWER SUPPLY DEAL

Amazing surplus stock purchase. GME Electrophone 240V input 12VDC output at a huge 2.2 Amps. Unit is a desk top type, with 240V power lead (length 1.8mt.) and 12V lead (length 1.8mt.) terminated to a 2.5mm DC plug centre positive. Size 130(L) x 90(W) x 65(H)mm.

Cat. MP-3040

These normally sell for $69.95

Only $35 ea

HALOGEN LIGHT SETS

20 WATT LARGE SIZE KIT

Includes •20W lamp - 51mm dia. •Downlight holder (white) •Mains t'former, power lead

Cat. SL-2750 **Save $6.90**

Normally $34.85 Kit Only $27.95

50 WATT LARGE SIZE KIT

Includes •50W lamp - 51mm dia. •Downlight holder (white) •Mains transformer, power lead Cat. SL-2752

Save $6.90 Normally $34.85

Kit Only $27.95

20 WATT SMALL SIZE KIT

Includes •20W lamp - 35mm dia •Downlight holder (white) •Mains transformer, power lead Cat. SL-2755

Save $6.90 Normally $34.85

Kit Only $27.95

SAVE ON CELLULAR BATTERIES

NOKIA 2010

NI-MH 1200MAH

24 hr. standby, 120 min. talktime.

Cat. SB-2564

Was $45 Save $10

July $35

PHILIPS FIZZ

NI-MH 1800MAH

33 hr. standby, 150 min. talktime.

Cat. SB-2590

Was $69.95 Save $20

July $49.95

RECORDABLE CD'S

SAVE

Quality Mitsubishi brand.

Cat. XC-4710 Was $16.00

Now $12.95 each or 10+ $11.50 each

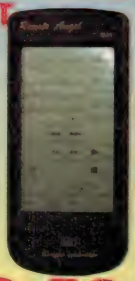
CAR SPEAKER SPACERS

These spacers are ideal if there simply is not enough room behind car panels to accommodate the speakers. The 6" are 25mm deep and the 6 x 9" is 38mm deep. Both are black in colour. The 6" will fit the following Jaycar car speakers, CS-2258, CS-2262, and CS-2284 and most 6" car speakers. The 6 x 9" will fit the CS-2268 and CS-2290 and most 6 x9' car speakers.

FOR 6" SPEAKERS Cat. AX-3580 **$19.95 pr**

FOR 6x9" SPEAKERS Cat. AX-3584 **$23.95 pr**

REMOTE ANGEL SELLOUT



The best remote See 97 Cat P171.

Cat. AR-1720

Cat. Price $169.50

Save $30

July $139.50

FREE MAT WITH MOUSE!

Buy our Super Mouse II at $19.95 and receive FREE a Jaycar Mouse Mat worth $4.95 Cat. XM-5110/XM-5095

Only $19.95

JV110 VIFA 10" SUBWOOFER DEAL

Woofer M26WR-10" Cat. CW-2118 **$229.50**

Cabinet (no baffle) Cat. CS-2552 **$149.00**

Baffle Cat. CS-2556 **$30.00**

Polyswitch RN-3472 **$10.95**

Total $419.45

Save $120.45

July Deal Only $299

12 VOLT 5MM HIGH BRIGHTNESS FLASHING LED

Ultrabright 300 mcd 5mm red LED, which is ideal for car alarm deterrent light. No dropping resistor needed. Specifications: •IV (mcd) at 9V - 300mcd •Power dissipation - 200mW •DC forward current - 38-56mA •Reverse voltage - 0.5V

Cat. ZD-1785 **$1.75ea.**

RJ12 MINI LEAD

This connects from a US wall socket (or Oz/US adaptor) to a cordless phone or answering machine that is wall mounted. No more dangling cables!!! Length - 150mm - RJ12 plug on each end. **Cat. YT-6044**

ONLY $4.50

SCOOP PURCHASE - 2 LINE 16 CHARACTER LCD DISPLAY

Not new - removed from poker machines to make way for more advanced technology. Guaranteed to work as a display but backlight will probably not work. If you want a backlit panel do not buy this unit. All decoder & drivers are on board. You can generate a full upper & lower case alphanumeric display as well as Japanese characters and symbols such as pi, sigma, omega etc. Note, we emphasize that the units are second hand & have been soldered to. They have been removed by professional technicians. 6 x 3mm (approx) character height. Overall display 28W x 72L x 4Hmm.

Cat. ZD-1890 **A Bargain At $9.95**

LASER POINTER

Don't pay $69 they are only $49 at Jaycar in July SAVE $20 Cat. ST-3100

6.5MM STEREO PANEL SOCKETS

Enclosed case, DPST switched, normally closed. Limited quantity available. **Cat. PS-0181**

Only $1.75

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

LCD "VERNIER" TYPE ENGINEERS CALIPERS

Stainless steel, digital readout, 0 - 150mm range. See 1997 Cat. page 106 for details.

Cat. TD-2082 **Only $99.95**

COMPUTER MICROPHONE HEADSET

Lightweight, with adjustable mic. boom. Weighs only 65 grams. See 1997 Cat. page 160 for details.

Cat. AA-2028 **Only $19.95**

PA DRIVER AND HORN COMBO

SCOOP PURCHASE

Attention PA Enthusiasts

We have purchased a quantity of Motorola KSN1142 piezo drivers together with the Sammi SH-350 professional horn. If you require audience penetrating projection, together with huge power, this fantastic combo will compliment any two way speaker bin. •Horn type: exponential •Horn cut off:600Hz •ABS resin •Dispersion: 120x90° •Throat dia: 24mm •318Wx198Hx211Dmm •Piezo power: 400WRMS •Freq resp: 1.8K to 20kHz. Three year warranty on driver. Last year if you purchased the 2 individually you would of paid $144 **Cat. CT-1930** LIMITED QUANTITY AVAILABLE

ONLY $89 SAVE $55

SPEAKER/MICROWAVE BRACKET

Mount heavy speakers, TV or a microwave on a wall with this bracket. Has adjustable depth from 375 to 570mm, wall bracket length is 420mm maximum width. Will handle 31kgs and colour is black.

Cat. CW-2820 **Only $24.95**

HEAVY DUTY CABLE CUTTERS

8" long and cuts thick cable. Cat. TH-1898

Was $14.95 Save $5

July $9.95

UNIVERSAL SCREW ASSORTMENT

This pack contains 20 sizes of the most popular screws used in VCR's, CD players, amplifiers etc. Each screw has a head with a Pozidrive/Philips driver slot. 10 pieces of each screw provided. 200 pieces in all.

Cat. HP-0102

Was $12.95

July $7.95

Save $5.00

TURN YOUR SURPLUS STOCK INTO CASH!

Jaycar buys surplus/distress stock of most electronic products from components to built products. If you have marketable quantities of stock you need to clear contact Bruce Routley or Mark Ostro on

Phone: 02 9743 5222

Fax: 02 9743 2066

SOLDERING IRON STAND

Cat. TS-1500

Was $10.95

July $7.95 Save $3.

5V IN 110VAC OUT LOW POWER INVERTER

As removed from equipment by competent professional techs. These potted units measuring 18mm wide x 17mm high by 24mm long will accept a 5VDC input to produce a high voltage (low current) AC display for fluorescent back lighting for electroluminescent panels etc.The 110V can be rectified & filtered (if necessary) for a low current high voltage 130VDC supply as well. Ideal for experimenters! Includes wiring diagram. NOTE: Second hand but guaranteed to work. **Cat. MI-5010**

$3.95ea or 10 for $20

6 SECTOR HOME BURGLAR ALARM DEAL

Save a fortune by buying our ALARM DEAL NO 1 using the Jaytech 4500 panel. Includes all the components needed to give you a quality basic home alarm system. All you need is a bit of labour and you have a reliable affordable alarm that offers you peace of mind. Please note, panel has blue facia.

PROTECT YOUR HOME FOR UNDER $200!

INCLUDES:	NORMAL PRICE
1 x 6 sector Jaytech panel	$109.50
2 x Micron pulse count PIRs	$59.90
1 x mains power supply	$21.50
2 x reed/magnet switches	$11.50
1 x siren horn	$25.95
2 x deterrent stickers	$4.00
50 m of 4 core alarm cable	$28.00
NORMALLY PAY	$260.35

Cat. LA-5450 **$199**

DSC 5 Sector Alarm Deal

This system includes the DSC 5 sector alarm panel with Austel Approved dialler. Connect it to an alarm company or it can phone you or your neighbours etc.

THE BEST DSC Security Products

INCLUDES:	NORMAL PRICE
1 x DSC 5 zone alarm/dialler	$285.00
3 x Bellmate 100 PIRs	$119.85
1 x mains 3 wire power supply	$24.95
1 x 6.5Ah backup battery	$43.50
2 x reed/magnet switches	$11.50
1 x strobe	$19.95
1 x metal siren cover	$29.95
1 x siren horn	$25.95
1 x internal siren	$19.95
2 x deterrent stickers	$4.00
100 m of 6 core alarm cable	$88.00
NORMALLY PAY	$672.60

Cat. LA-5460 **Only $599**

POCKET SHIFTER MULTITOOL

Includes •Shifter with 18mm jaw opening •Phillips head screw driver •Slotted screwdriver •File •Canopener •Bottle opener •Knife •Supplied with holder and belt clip •Made in Taiwan.

Cat. TH-1905 **Was $19.95**

July $14.95 Save $5.00

12V WIND UP EXTENSION REEL

The cable length is 4 metres. The reel has two cigarette lighter sockets for powering equipment. Current 10A.

Cat. PP-2016

Was $12.95

July $8.95

Save $4.00

NEW KIT

ADD-ON REGULATOR KIT FOR 12V BATTERY CHARGERS

Refer: Electronics Australia July 1997. This simple kit converts a 'bare bones' automotive battery charger into a fully regulated charger that can be left connected to the battery indefinitely. Once the battery reaches a pre-determined voltage, the charger is switched on and off to maintain that value indefinately. Kit is supplied with PCB plus all specified electronic components. CHARGER & CLIPS NOT INCLUDED

Cat. KA-1795 **Only $22.95**

DIGITAL SNOOZE ALARM CLOCK

This alarm clock will mount on a wall! It will also stand up by itself on a table. It features large digits, snooze feature, it illuminates at the touch of a button and is 12 or 24 hour format.

Bracket supplied with double sided tape for mounting on wall, window, car etc etc.

Cat. XC-0226 **Was $19.95**

July $14.95 Save $5

RCA SOCKET MOUNTING KIT

This kit allows you to mount and insulate RCA sockets in a metal panel. The RCA sockets suited are single hole types PS0256/7 and PS0258 gold. As used in many audio kits. Pkt 10 plastic grommets and fibre washers.

Cat. HP-1180 **Pkt 10 $2.95**

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

CAR ALARM DEALS - AMERICAN LEGEND / EQUATOR

American Legend Car Alarm

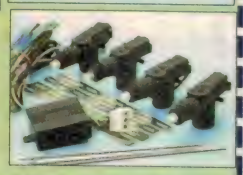
Features learning remotes:
See 1997 catalogue page 73.
Deal 1: Buy the alarm at $139.50 and pay only $10 extra for the siren. (LA-8908)
Total $149.50 Save $15.95
Deal 2: Buy the alarm at $139.50 and pay only $30 extra for the battery back up siren.
Total $169.50 Save $29.95
Deal 3: Buy the alarm and battery back up siren and 4 door central door locking for only **$249** and save **$39.50.**

ALARM	$139.50	LA-8912
SIREN	$60.00	LA-8910
LOCKING	$89.00	LR-8830
Normally	$288.50	
$249 and save $39.50		

LA-8908 LA-8910

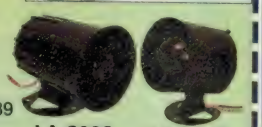
Equator Car Alarms

See cat for full details



EQUATOR LA-8902
Deal 1: Buy the alarm at $169 and pay only $10 extra for the siren. (Siren LA-8908) **Total $179.00 Save $15.95**
Deal 2: Buy the alarm at $169 and pay only $30 extra for the battery back up siren (Siren LA-8910).
Total $199.00 Save $29.95
Deal 3: Buy the alarm and battery back up siren and 4 door central door locking for $269 and save $48
ALARM: $169.00 SIREN: $60.00 LOCKING: $89.00 **Normally $318**
Total $269 Save $48

EQUATOR LA-8905
Deal 1: Buy the alarm at $229 and pay only $10 extra for the siren. (Siren LA-8908) **Total $239.00 Save $15.95**
Deal 2: Buy the alarm at $229 and pay only $30 extra for the battery back up siren (Siren LA-8910).
Total $259.00 Save $29.95
Deal 3: Buy the alarm and back up battery siren and 4 door central door locking for only $329 and save $49.
ALARM LA-8905: $229 SIREN LA-8910: $60 LOCKING LR-8830: $89
Normally $378 Total $329 Save $49

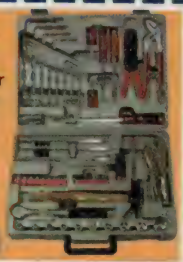


LA-8908 LA-8910

40 PIECE TOOL KIT

See 1997 Cat. P99 for full list. Cat. TD-2100
Was $24.95
July $19.95
Save $5.00

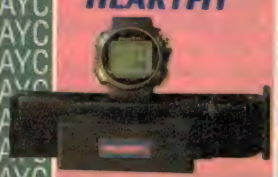
100 PIECE TOOL KIT



See 1997 Cat. P99 for full list. Cat. TD-2102
Was $49.95
July $39.95
Save $10.00

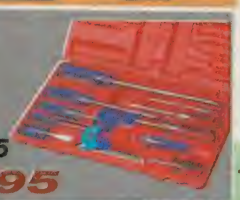
BOTH INCLUDE BONUS TYRE PRESSURE GUAGE

SAVE $20 ON "HEARTFIT"



High performance heart rate monitor. See 1997 Cat. page 178 for full deails. Cat. QM-7240
Was $99.95
July $79.95
Save $20

10 PC SCREW DRIVER SET



Supplied in case - includes 4 Phillips and 6 slotted screwdrivers.Cat. TD-2015
Was $19.95 Save $5
July $14.95

REMOTE POWER-UP KIT FOR PC'S

REF: EA JUNE 1997
Dial a remote computer and retrieve files. Can also be used to turn on mains appliances. Kit is complete with modem-style case, front panel label, PCB, transformer plus all electronic components. Software available from the Electronics Aust. bulletin board.

CELLULAR PHONE / VIDEO CAMERA / 12V / 240V/ AAA / AA / NI-CAD / NI-MH BATT. DISCHARGER / DEEP CONDITIONER CHARGER

Supplied with charging plate for Motorola Microtac battery. Adaptors for other batteries available at extra costs. See list. See 97 Cat. on page 77 for full details.

VIDEO CAMERA BATTERY ADAPTORS:
- Sharp, Hitachi, Sony **Cat MB-3565**
- Panasonic, Canon, JVC **Cat MB-3566**

AA / AAA BATTERY ADAPTORS:
- AA x 6 **Cat MB-3570**
- AAA x 6 **Cat MB-3572**

ALL ADAPTORS $12.95 each

ADAPTORS FOR OTHER BATTERIES:
•Motorola Microtac: Supplied with charger
•Motorola 8000/9000/9800 7.2V Cat MB-3555 **•NEC P3/P300 6.0V** Cat MB-3556 **•NEC P388/P4/P6/P400/P600/P601** Cat MB-3574 **•Ericsson 237/337 6.0V** Cat MB-3557 **•Ericsson 197/198/172/818** Cat MB-3576 **•Oki 700 6.0V** Cat MB-3558 **•Nokia 2110 6.0V** Cat MB-3559 **•Nokia 101/121** Cat MB-3560

CHARGER INCLUDES:
- Power supply (240V to 12VDC 1A)
- Cigarette lighter lead.
- Motorola Microtac adaptor.

CHARGER Cat. MB-3550
Only $69.95

JV100 10" 3 WAY 5 SPEAKER KIT

See 1996 Catalogue page 47 for full details.

NORMALLY		
Speaker kit	Cat. CS-2550	$1,199 Pr
Cabinets	Cat. CS-2552	$378 Pr
		$1577 Pr

July buy together $999pr Save $500

Quote from Leo Simpson - Silicon Chip on JV100's
"This speaker really performs, with prodigious power handling and beautiful bass down to below 30Hz. But as well as power handling and extended bass response, the system is very satisfying in its handling of all types of music with a smooth midrange and very clean treble reproduction."

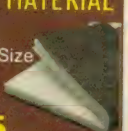
SPEAKER GRILL CLOTH

Black in colour.
Size 1.5 x 1M. Cat. CF-2752
Normally $16.50
July $12.50
Save $4.00

SPEAKER CARPET

Cover PA bins & car subs.
Black in colour. Size 1 x1.8m.
Cat. CF-2755 July $32.95

"JAYBOND" SPEAKER DAMPENING MATERIAL



White one side, grey the other. Size 700mm x 1m.
Cat. AX-3690
$6.95

The "Full House" Power Driver Bit Set

New 4N07

All the weirdo driver bits in one go!! -The set consists of 32, of the driver bits that you don't normally see. You don't get any slotted, Phillips or Posidrive bits.
You do get: •4 x Tri - wing, size 1, 2, 3, and 4 •9 x Torx (tamperproof), size T8, T10, T15, T20, T25, T27, T30 and T35 •4 x Pin drive (snake), size 4, 6, 8 and10 •6 x In - Hex (allen), *metric, size 2, 2.5, 3, 4, 5 and 6 •6 x In - Hex (allen), *imperial size 5/64", 3/32", 7/64", 1/8", 9/64" and 5/32" •3 x Torque Set, size 8, 9 and 10. With this you get a hex driver with magnetic retainer, all in a nifty plasticy - rubber holder that is smaller than a deck of cards! (67 x 45 x 30mm). you will never get stopped by a wacko screw ever again!!
Cat. TD-2035 Was $29.95 Save $8.00
NEW LOW PRICE $21.95

RS232 MINI PATCH BOX

Make custom interface. D25 male/female.
Cat. PA-0880
Was $6.95
July $4.95
Save $2.00

ETHERNET LAN CARD

Cat. XC-4650
Cat. Price $69.95
Save $15.00
July $54.95

SCOOP PURCHASE OF THE DECADE

BUY YOURSELF A PUNCH IN THE KIDNEYS

IF YOU THOUGHT SUB-WOOFERS WERE LOW - WAIT FOR THIS!!!

AURA INTERACTOR

The "AURA INTERACTOR" is a device that you strap to your body to give an extra dimension to listening to Hi Fi, watching a video, experiencing a computer simulation or game or playing a video game etc. What is this extra dimension? You strap this thing on you and experience - through your body - the punches and kicks from martial arts games, explosions and subsonic roar through home cinema or TV games, tackles, slam dunks etc. The heart of the system is a substantial electromagnetic transducer which is like a speaker but without a cone (see box). The transducer is mounted inside a rigid plastic enclosure which straps on to you just like a back pack. A lead from the back pack connects to a filter/amplifier.

The filter/amp then connects to your program source which could be:

- **TV or VCR**
- **Laser Disc Player**
- **CD Player**
- **Walkman**
- **Video Game Console**
- **Hand Held Game**
- **Computer Sound Card**

In fact any audio source which you know has some low frequency information.

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Construction project:

MODULATOR/MIXER FOR SECURITY CAMERAS

Imagine: You are sitting at home watching television late one night, when you hear some strange noises coming from outside. You lean over and press a button on your TV's remote control, and up pops a view of the driveway. You press another button, and you can now see clear around the side of the house. One last command from the remote gives you a view of the back garden, with a possum escaping over the back fence. Aren't you glad you built this project?

by GRAHAM CATTLEY

There's no doubt that video surveillance systems add peace of mind to any household, and with the recent fall in the cost of miniature camera modules, such a system is not out of the question for even a modest home security system.

This project uses a simple modulator/mixer unit to combine the signal from a miniature video camera with the RF signal coming in from the television antenna. This results in the camera's signal appearing as a extra UHF 'station', along with the other television stations. So you can then tune into the camera's signal using your normal television receiver — just by flipping to the camera's own channel. An added advantage of this system is that a number of cameras (each with their own mixer unit) can be added at any time, each tuned to its own separate channel. So UHF channel 42 could be watching the front door, while channel 48 might be monitoring the driveway.

The main advantage of this system is that it eliminates the need for any extra cabling around the house, as the video is fed in through the existing antenna feed line. And because it doesn't need any extra equipment to receive the signal, installation of the system is simple and cheap.

A surveillance system of this type lends itself well to smaller apartment blocks, or groups of units that share a common television antenna system. By installing the mixer in series with the antenna, the video from the camera will be available to *all* of the separate units as another channel on their television. So a common parking area or garden could be monitored 24 hours a day, and any resident in the group could tune in and check at any time.

As this system will support a number of cameras, each tuned to a different channel, the mixer has been designed so that extra mixers (one for each camera) can be 'daisy chained' into the antenna lead at any time.

With a little ingenuity, an advanced security monitoring system could be devised with PIR sensors mounted next to each camera. With these sensors wired to a remote control unit, any movement in a particular sector would automatically switch the TV or VCR to that channel to monitor the event. In a dedicated system such as this, up to 10 cameras could be accommodated.

The circuit

A quick look at the circuit shows that almost all of the work is done inside the mixer/modulator module. This module accepts the 1V p-p video signal from the camera, and translates it up into the UHF band, with the carrier frequency adjustable over the UHF 28 - 40 channel range. This signal is then mixed with the RF signal coming in from the television antenna, and the resulting mixed signal is then fed down the existing antenna wiring to the television receiver. The mixer module can also provide a 7dB boost, which amplifies the incoming RF signal from the antenna, and can help overcome any losses in the system. This may not be needed in some cases, and so it can be switched in or out by a toggle switch on the front panel.

Another useful feature built in to the module is a test pattern that can help when setting up the system. This can confirm that the module is working correctly, and comes in handy when setting up the system — particularly when several units are used. The test pattern is enabled by a small slide switch on the front face of the unit, and when activated it produces a pair of white bands down a black screen on the television.

The rest of the circuit consists of a pair of power supplies, one to supply 5V to the mixer and the other to power the camera.

This second supply is adjustable from 5V up to 12V, so that different camera voltages can be accommodated. Voltage selection is provided by VR1 and R1, while C1 to C4 prevent the regulators from breaking into high frequency oscillation. SW1 supplies power to the booster amplifier inside the module, and R2 terminates the incoming video signal from the camera to prevent reflections in the cable, and to provide the correct video input level of 1V p-p.

Construction

Construction of the Modulator/Mixer is quite straightforward, with the bulk of the work in drilling the required holes in the case. If you are buying a kit with a pre-punched front panel, this may have been done for you; if not, you will need to use a photocopy of the front panel artwork as a guide.

Be careful when drilling the five holes for the mixer module, as these will need to match up exactly with the plugs, sockets and switches once the unit is assembled. The best method is to drill the holes too small, and carefully enlarge them with a tapered reamer or rat-tail file — continually checking hole size and position with the module as you go.

Try not to make the holes for the RF in and RF out sockets any bigger than necessary, as this will prevent the module from turning on its mounting screw and perhaps working loose. Also, don't forget to drill two holes at the end of the box for the 2.1mm DC power connectors. These should be drilled low enough so that the sockets don't foul against the other components when the unit is assembled.

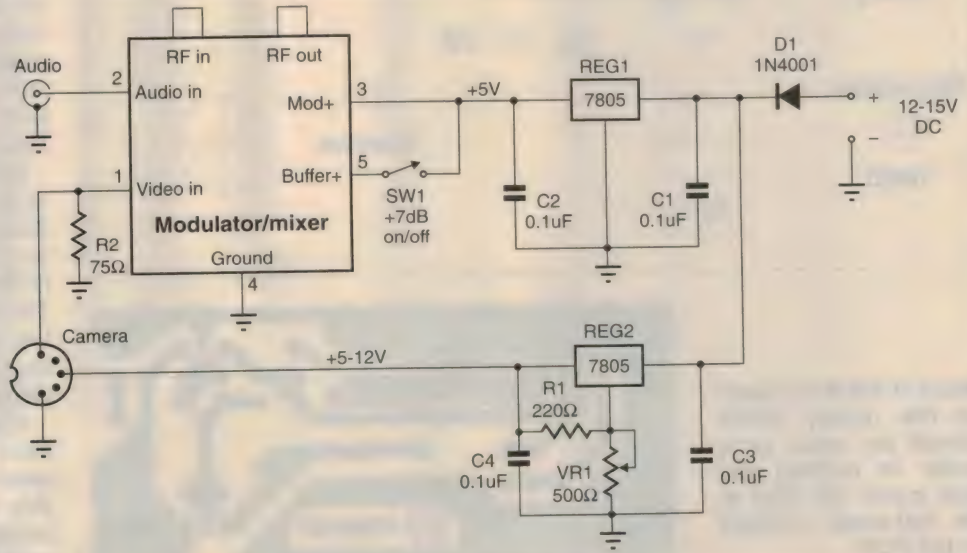
All of the components mount on a small (77 x 35mm) PC board, and it is best to start by installing the eight PCB terminal pins before moving on to the resistors and capacitors and the two regulators. The mixer module should be mounted last, as it makes the PC board hard to handle. Make sure that you solder the mixer's four mounting lugs to the board, as these are used to support the board once everything is mounted in the case.

This shot shows how the board is supported by the mixer when installed inside the case. Note that the two power sockets are wired in parallel, so that a short jumper cable can be used to supply power to another unit.

Mount the 5-pin DIN and RCA sockets along with the Boost toggle switch in the front of the case, but don't mount the two power sockets yet as these will need to be wired together first. These two sockets are connected in parallel, and one of them is used to supply power from the plugpack to the circuit. The other socket is used as a power output, which can be used to provide power to any other units daisy-chained onto the first. (If you only need one camera, and don't intend to add any extra modules, you can do away with one of these DC power sockets altogether.)

Solder a pair of 100mm-long wires to the sockets, and mount them in the case. Next, tin both ends of a pair of 30mm wires, and solder them to the Boost switch pins on the board. The PCB/module assembly can now be secured to the lid of the box, and held in place with a self-tapping screw through the hole between the two RF sockets.

You should now be able to solder the free ends of the Boost leads to the switch, and make the power connection to the edge of the board. The DIN socket can now be connected to the four PC pins below the mixer module, using a 90mm length of four-way ribbon cable. You can wire the DIN socket any way you like, but be sure to make a note of the connections because you will need to know them when it comes to wiring the DIN plug onto the end of the camera cable. The audio socket is simply wired across the 'Audio in' pin and ground on the DIN socket.



The heart of this circuit is a mixer/modulator module that translates the incoming video signal up into the UHF band and mixes it with the TV signal coming in from the antenna. REG1 supplies 5V to the module, while REG2 supplies 5-12V to the camera.

Double check your wiring, especially around the DIN socket (a mistake here could damage the camera), and also check that the top of the regulator REG1 doesn't hit the back of the Boost toggle switch.

Camera cable

The camera is connected to the mixer by a suitable length of shielded cable. For short to medium runs this can be twin-core audio screened cable, which will allow you to run the camera power up one of the lines and the video back down the other, with the earth connection made via the shield. This is probably the cheapest and easiest approach, and will serve in most installations. For long runs, you may need to use 75-ohm coax to prevent reflections and ghosting, and thus need to run a separate line out to power the camera.

Assuming that you are using the twin core screened cable though, connect one end to the camera (using the appropriate connector), and terminate the other end in a 5-pin DIN plug, making sure that the video, power and earth connections match the wiring in the socket.

Testing

The mixer module itself can be tested by simply unplugging the antenna lead from the back of the television and plugging it into the 'RF in' socket on the box. The television is then connected to the 'RF out' socket using a male to female antenna lead (these are often sold as antenna extension leads).

With the video camera *unplugged*, connect a 12-15V DC plugpack, and switch the 'Test pattern/Video' switch to the test pattern position. If you now tune the television around UHF channel 28 to 40, you should be able to pick up the mixer's test pattern of a pair of bright white stripes down the screen.

PARTS LIST

Resistors

R1	220 ohms
R2	75 ohms
VR1	500 ohm mini trimpot

Capacitors

C1,2,3,4	0.1uF monolithic

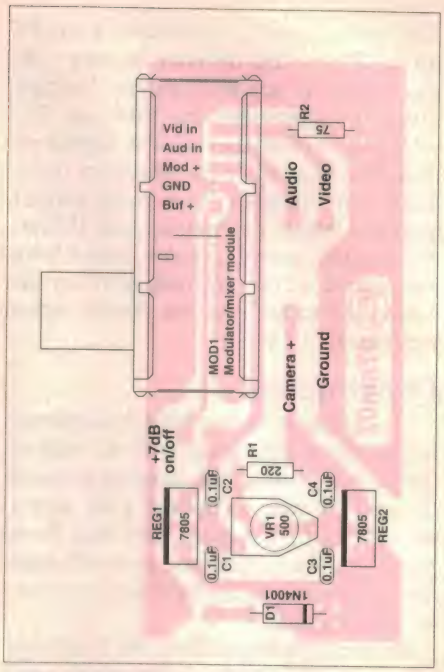
Semiconductors

D1	1N4001 power diode

Miscellaneous

Modulator/mixer module; PCB measuring 77 x 35mm, and coded 97sm07; 5-pin panel mount DIN socket; Panel mount RCA socket; 2 x 2.1mm panel mount DC sockets; 45 x 130 x 65mm plastic box, hookup wire, nuts, bolts etc.

The mixer module for this project is available from Allthings Sales and Services for $30 (less for quantity) plus $3.50 for packing and postage. Their address is: Allthings Sales and Services, PO Box 25 Westminster, WA 6061. Phone (09) 349 9413, or fax (09) 344 5905.



When installing the mixer module you may need to enlarge the four mounting holes to 2mm in order to accomodate its mounting tabs.

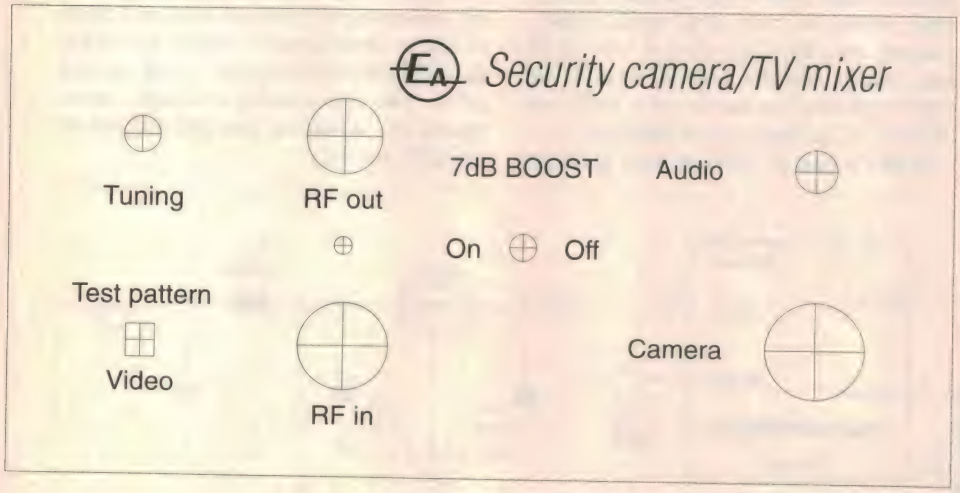
Now tune the set to a channel clear of existing TV transmissions, and carefully adjust the small trimmer accessible through the hole in the front panel until the test pattern is received clearly. You should now be able to receive all your normal TV stations as as before, as well as this new 'video' channel.

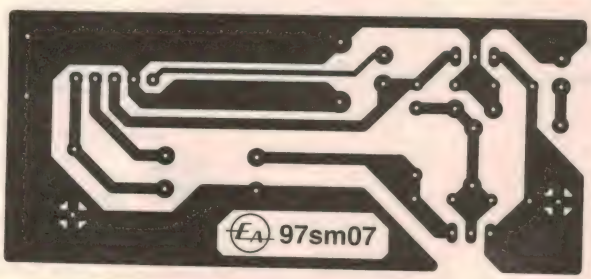
You can now plug in the camera and move the switch from 'Test pattern' to 'Video', and (if you've wired everything up correctly) the camera's output will be displayed on screen.

As far as installation is concerned, that will largely depend on the application and location of the system, but there are a couple of points to keep in mind. Firstly, the mixer isn't waterproof, and so should be mounted up and out of the way of any rain or harsh weather. Somewhere in the attic or loft close to where the antenna line comes in would be ideal.

Secondly, the main antenna feed should be broken, and the free ends fitted with a Belling-Lee (standard 75 ohm coax) plug on the antenna end, and a matching socket fitted to the line heading off to the TV. The mixer module can then be inserted in line, and even removed at a later date if required, with the old antenna line simply plugged back together.

One last point — don't forget that most mini video cameras are quite sensitive to infra-red light. With suitable IR illumination, it is possible to monitor an area in what seems to be total darkness. ❖





Above is the front panel for the mixer, which should be used as a guide in drilling the front panel. At right is the full-sized artwork for the PCB.

SHORTWAVE LISTENING

with Arthur Cushen, MBE

BBC audience increases to 143 million

The BBC Audience Research Unit has recently updated its survey of listeners worldwide and there has been a substantial increase in the numbers. It is now estimated that 143 million listeners tune to the BBC at least once a week.

The figures were released by Dr Graham Mitten, Head of the Audience Research Unit in London, and included some recent audience surveys for countries such as Nigeria. Some of these countries have been difficult to count in the past, though they have a substantial BBC audience. This also is the case with many West African countries, which have allowed the BBC to install a relay of their programme, generally on FM. This means that the BBC is reaching a greater audience through local reception.

The new figure shows the BBC to have the largest radio audience of any station and is an important benchmark, as it is the number against which all other international broadcasters can compare their own audiences. There has been an increase of three million listeners in the past year.

Dr Mitten says that the ideal situation would be to survey the audience each year. But this is not possible, so some of the figures are based on earlier surveys. The countries where the largest audiences are found include Nigeria, Pakistan, India, Bangladesh and Russia, and these countries are researched more often than others.

The increase due to the BBC establishing AM and FM relay points of their programme covered most of West Africa, but the boost in the audience on FM is only in the populated areas. It is on AM that they get a wider coverage and an increased audience.

The survey shows that well over 100 million of the audience listening to London do so via shortwave, with the other 43 million receiving the signals through local radio services. There is a sizeable proportion listening to BBC mediumwave coverage in the Middle East, while there is a slowly increasing number who are tuned to an FM outlet. Dr Mitten concluded that shortwave is still the most single important means of listening to the BBC.

New stations

The Mauritius Government is making arrangements with Luxembourg to fund a new shortwave transmitter on this Indian Ocean island. Many years ago Mauritius was often heard on shortwave, but the service was closed. Now the Government has a new view of shortwave broadcasting and plans to use the facility to boost tourism and economic development — particularly with the country's neighbours in East Africa.

The plan is to install a 100kW transmitter and this will be installed in the northern part of the island. Two frequencies have been allocated, 4855 and 9710kHz. Once the Luxembourg Government has agreed to fund this aid project, the transmitter will be ordered and operation should commence later this year. So we can look forward once again to hearing Mauritius on the shortwave bands.

In the United States the increasing number of shortwave stations has been noted and the latest is a new broadcaster to be located at Macon, Georgia. A construction permit has been granted and the station expects to commence operation in January 1998. The transmitter will be of 50kW and it is being built by its owner. Application has been made for the use of 11,910kHz for broadcasting. The antenna will be rotatable and the transmitter and studios are at 300 Poplar Street, Macon, Georgia. The station will air primarily religious broadcasts from 0000-1200UTC.

Maldives back on air

The Voice of the Maldives is soon to return to shortwave, probably later this year. The station's mediumwave transmitter in the city of Male can provide reliable reception to listeners in the southern part of the country. Australia, which has donated much of the other Maldives equipment, has agreed to provide a shortwave transmitter and the President of the Maldives is to visit Australia for the handing over of the transmitter. It is expected that the transmitter will use a frequency in the 60-metre band and will have a power of 1500W. ❖

AROUND THE WORLD

ALBANIA: Radio Tarana's new schedule shows broadcasts to Europe 0145-0200 on 6115 and 7160kHz; 1845-1900 on 7270 and 9570kHz; and to the USA 0230-0300 on 6140 and 7160kHz and 2100-2130 on 7110 and 9510kHz.

AUSTRIA: ORF to the Pacific has English at 0930 on 17,870kHz; to the Far East on 15,455kHz; and to North America at 0530 on 6015kHz via Sackville.

BULGARIA: The latest schedule for English broadcasts by Radio Bulgaria in Sofia includes 0400-0500 on 9485 and 11,720kHz to North America; 1200-1300 on 13,790kHz to Asia; 1900-2000 and 2100-2200 on 9700 and 11,720kHz to Europe.

CANADA: Radio Canada's schedule which we monitor is: 0400-0430 on 9715, 11,835 and 11,975kHz; 0500-0530 (Mon-Fri) on 6050, 7295, 11,835 and 15,430kHz; and 2000-2129 on 11,690kHz, 13,650, 13,670, 15,150, 15,325, 17,820 and 17,870kHz (this last frequency to 2059). The 0400 broadcast is relayed on 9715kHz from Skelton, UK; the 11,835kHz is from Wiertachtal, Germany and 11,975kHz is from Vienna, Austria. All other broadcasts originate from BBC Skelton.

ECUADOR: HCJB is broadcasting to the South Pacific at 0700-1130 on 9645kHz.

GERMANY: Deutsche Welle's new schedule shows to Asia and the Pacific 0900-0950 UTC on 6160kHz, 12,055, 17,715 and 21,680kHz; and 2100-2150 on 7115kHz, 9670, 9765 and 11,785kHz.

HAWAII: KWHR now carries Radio Free Asia 1400-1500 on 9930. The programme is in Vietnamese, but there are early reports of severe jamming in the target area.

JAPAN: NHK's latest schedule does not list the service to Oceania. The best frequencies would be: 0600-0800 on 17,810kHz; 1100-1300 on 7125 and 11,815kHz; 0500-0800 on 11,840kHz; and 0600-0700 on 15,550kHz. The shortwave programme Media Roundup was cancelled at the end of March.

MONGOLIA: The Voice of Mongolia's latest English schedule shows 0900-0930 on 15,170kHz; 1230-1300 on 12,085kHz to Australia; and 1500-1530 on 9720 and 12,085kHz to the Far East. The station requests two IRC's with reports and the address is: PO Box 365, Ulaanbaater 13, Mongolia. There is severe interference from Norway on the frequency of 15,170kHz.

NEDERLANDS: Radio Nederland is broadcasting to the Pacific 0730-0930 on 9720 and 9820kHz from Bonaire; and 0930-1030 on 12,065 and 13,710kHz from the CIS.

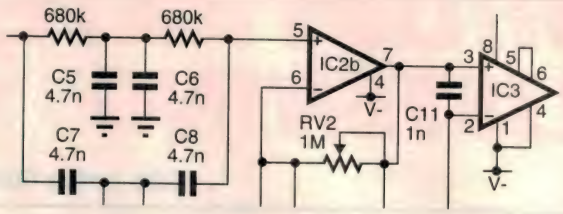
SWEDEN: Radio Sweden is heard in the Pacific with English 1230-1300 on 13,740 and 15,240kHz; 1330-1400 on 13,740kHz; and 0130-0200 on 9435kHz.

SWITZERLAND: SRI in Berne broadcasts in English to the Pacific 0900-0930 on 9885, 13,685 and 17,515kHz; to the Far East and South-East Asia in English 1100-1130 on 13,635, 15,415 and 17,515kHz; and to North America 0400-0430 on 6135 and 9885kHz, and extended to 0500 on 9905kHz. ❖

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time and 12 hours behind New Zealand Standard Time.

$10 Wonders

by OWEN BISHOP



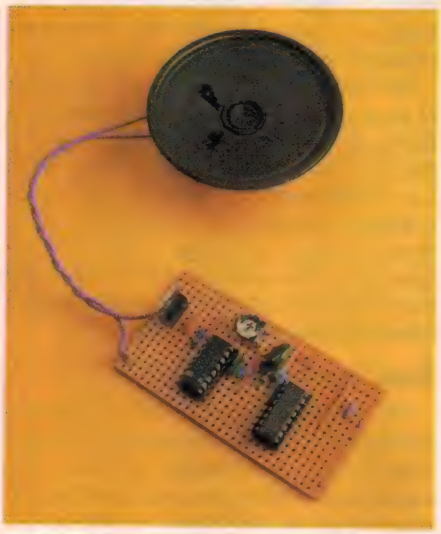
4: A Programmable Alert

In this installment, the author describes a simple circuit that can produce a range of different sounds, most of which are suitable for an alarm system of some kind. So read on, and with a little spare change and a hot soldering iron you can be beeping and buzzing away in no time.

I've called this project an 'alert' but you could also call it an 'alarm' — it depends on what you use it for and what you make it sound like. The circuit is very flexible, and it allows you to program it to produce your very own unique tone.

Basically, the circuit produces an intermittent tone, which is always much easier to pick out against a background of other sounds. The lengths of the tone bursts and the intervals between them can be varied from a fraction of a second to several seconds, and you can also set the pitch.

Readers with a little ingenuity and the time to play with the circuit on a breadboard will find that a wide range of other effects can be produced, from mournful wailings to (almost) cheerful chuckles. It can even warble like a telephone!



How it works

Fig.1 shows the circuit. The sound is generated by IC2, which is the same 4046 phase-locked loop IC that we used in last month's Two-up project. Once again, we use only the voltage controlled oscillator within this chip. The centre frequency of this oscillator is set by the values of C2 and R3, using the formula: f = 1/(R3 * C2). With the values used in the circuit described, this frequency is 666Hz. You can try making C2 or R3 smaller if you prefer a higher pitched alert.

The output from the VCO is pin 4 and the signal is fed directly to a power MOSFET (Q1), which drives the loudspeaker.

The VCO is controlled by the signal from IC1, a 4060. This IC contains a 14-stage binary counter/divider and the circuitry for building an oscillator. The rate of oscillation is determined by the values of C1 and R1 and is given by f = 1/(2.2 * R1 * C1). With the values given, f = 800Hz (approx.). This frequency is divided down by the counter/divider.

In Fig.2, the output is shown taken from pin 6, which is the output of the seventh binary stage, with a frequency of $800/2^7 = 800/128 = 6.25$Hz. This produces an urgently and rapidly bleeping note, rather like the 'hurry along' sound you sometimes hear at pedestrian crossings. At the other extreme, the output from pin 3 is the 14th stage, with a frequency of $800/2^{14} = 800/16{,}384 = 0.05$Hz (approx.). This note comes in 10-second bursts, with 10-second gaps between them.

By altering the timing components, R1 and C1, and by tapping into the divider chain at different pins, we can modulate the sound signal at almost any rate we chose. So long as you keep R2 ten times the value of R1, and keep C1 between 1nF and 10uF, you can change the value of almost every component and get a different sound each time. So experiment!

The circuit's average pitch can be adjusted by setting VR1, by the way.

Other effects can be produced in various ways and I'll leave the reader to explore these. For a start, you can try connecting a capacitor between pin 9 of IC2 and the +9V line. The effect depends on the value of the capacitor. Now how about adding a diode somewhere? As you can see, the possibilities are endless.

If you want to use the circuit as a door-alert or as an alarm for an invalid or elderly person, a pushbutton is the most obvious type of switch to use. For home security applications there are

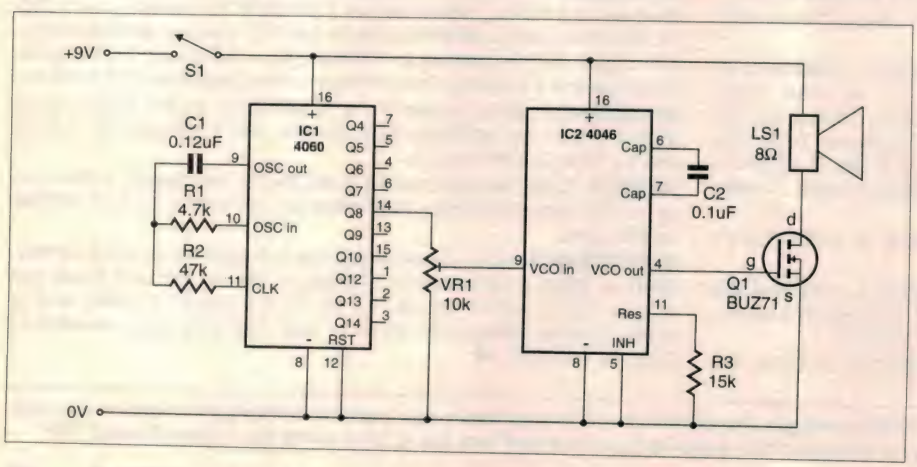


Fig.1: By tapping off various outputs from the binary counter IC1, the VCO inside IC2 can produce a wide range of attention-getting sounds.

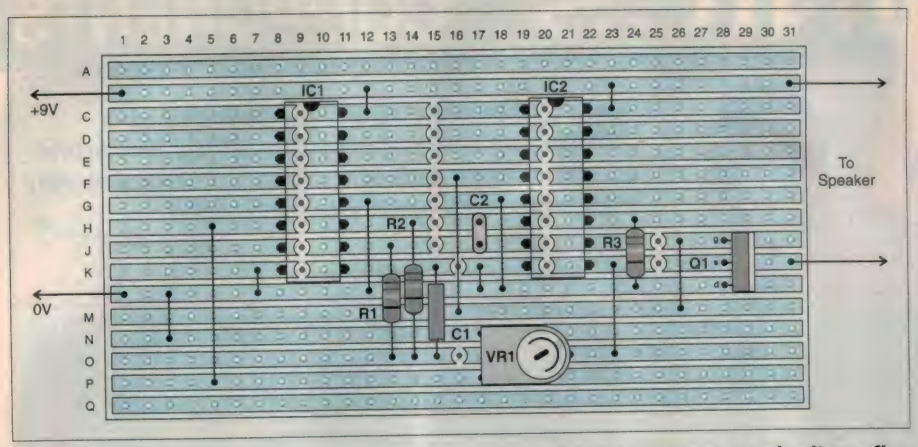


Fig.2: There's lots of room for experimentation with this project, so don't confine yourself to the configuration shown here. You might find it easier to experiment if you use a longer insulated wire for the jumper connected to pin 6 of IC1.

several types of microswitch which can be fitted to doors and windows. Most microswitches have changeover contacts and the circuit is wired to the normally-open pair, so that when the actuator, lever or plunger is pressed the contacts close and the alert sounds.

Microswitches can be used to protect valuable objects such as TV sets, computers and pictures as well. In this case the switch is positioned so that any attempt to lift the object and carry it away is detected by the microswitch. Often we wire microswitches the other way round for these applications, connecting the circuit to the normally-closed contacts, so that the object presses against the lever of the microswitch and holds the contacts open. When the object is removed, the contacts close and the alert is turned on. There are many ways of arranging booby-traps like this.

Another possible 'switch' is a pressure pad hidden beneath the carpet; this is often located just inside a doorway, so that anyone entering the room steps on the mat — when trodden on, contact is made and the alarm sounds. Next month's $10 Wonder shows how to protect the main door of your house, yet still allow you to leave home and return without setting off the alarm.

Construction

The circuit requires 200mA when it's sounding. But as it is not likely to be sounding for lengthy periods, it can be powered by a 9V battery of the PP3 type. The alarm uses only a small speaker; you could use a larger one which will make more noise, or you could run it on 12V or 15V to make it louder. For most domestic purposes the alert is more than loud enough as it stands, running on 9V and with a 70mm speaker.

Whatever size of speaker you use, it is essential to mount it firmly in a cabinet or baffle to obtain the maximum volume. Maybe you have an old radio set, intercom or tape player that will provide not only the speaker but the cabinet as well.

This is an easy circuit to set up on a breadboard, and an hour's experimentation before construction will let you decide on the programming. Check Fig.2 to see where to cut the copper strips (27 cuts in all). It is easiest to install the links first, followed by the resistors and capacitors. The trimpot is next, with the semiconductors soldered in last of all. (You can use IC sockets for IC1 and IC2 if you like.)

After that, connect the loudspeaker and a battery clip and plug in a 9V battery. With any luck the circuit should work first time. If not, check that you have cut the tracks in the right place, that all the component values are correct, and that there aren't any accidental solder bridges between tracks. As you'll find when experimenting, it's very hard to make this circuit *not* work! ❖

Parts list

Resistors

(all 5% 1/4 watt)

R1	4.7k
R2	47k
R3	15k
VR1	10k trimpot, mini horizontal

Capacitors

C1	0.12uF metallised polyester or MKT
C2	0.1uF metallised polyester or MKT

Semiconductors

IC1	4060 CMOS counter
IC2	4046 CMOS phase-locked loop
Q1	BUZ10/11/71 or other low-voltage power MOSFET

Miscellaneous

Pushbutton, microswitch or other type, according to application; 8 ohm miniature loudspeaker; Stripboard 80mm x 40mm (31 holes x 16 strips); 4 x 1mm terminal pins; 2 x 16-pin IC sockets; PP3 9V battery clip.

ALTRONICS COMPONENTS

ALTRONICS Fax Order Line: (08) 93

WINTER BARGAINS FROM ALTRONICS

Here are some excellent products and fantastic discounts for the winter. As some items always sell out quickly, I suggest you phone now to reserve your order!

Best Regards,
Jack O'Donnell, Managing Director *Jack O'Donnell*

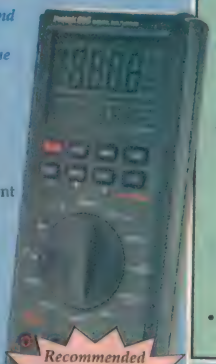
True RMS Digital Multimeter

Supplied with high quality hard carry case and silicon test leads. This 3.75 digit 4000 count digital multimeter would have to be one of the best meters we have seen.

Features: • True RMS • Large display with bargraph • 10 Location memory • Min, max, average and relative modes • Pulse signal generator for logic and audible testing etc • Continuity & diode test • Logic test • Auto power "off" and "keep on" mode • 20A current range • Back lit display • Data hold and run mode • Low battery indication • Overload protection • Design in compliance with UL 1244 and VDE0411

Specifications:

DC V:	400mV, 4V, 40V, 400V, 1000V
AC V:	4V, 40V, 400V, 750V
DC Current:	400µA, 400mA, 20A
AC Current:	400µA, 400mA, 20A
Frequency:	10kHz, 100kHz, 1MHz, 10MHz
Resistance:	400Ω, 4k, 40k, 400k, 4M, 40M
Capacitance:	100µF
Inductance:	100H
Temperature:	-17° - 1093° C (0° - 2000° F)
Display:	3.75 digit, 4000 count LCD



Recommended for Professional R&D or Laboratory Applications

Q 1091 Was $229, NOW ONLY **$199**

DOUBLE BONUS OFFER! Receive a FREE protective holster and temperature probe adaptor, together valued at $25.50 with every Q 1091. That's a total saving of over $50!

Our BEST Catalogue EVER!

The ALTRONICS 1997/98 Electronic Engineering Catalogue is OUT NOW!

If you don't have yours yet, call

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for your *free* copy!

- 212 pages • Dozens of exciting new products
- Expanded product data and specifications

Dome Tweeter 2-for-1 Bargain

These super responsive 25mm soft dome tweeters provide exceptionally smooth top end response for hi-fi and home theatre speaker systems. If you're building you own system or replacing worn out old tweeters, these may fit the bill! 8 ohms, 30 Watts RMS.

Amazing 2 for 1 Offer! SAVE 50%!

C 3002 Normally $35 each,

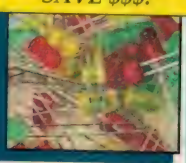
NOW **2 For $35**

5mm LED Pack

1/2 Price LEDs! Stock up your parts bin SAVE $$$!

Back by request, this pack contains **100 MIXED** 5mm LEDs in red, green, orange and yellow colours. Stock up your parts bin or grab some for your own kits!

***BE QUICK**, these won't last!*



Z 0002 5mm LEDs Pk 100, Value $25

NOW Only **$12.50**

Speaker Wire

ONLY .25¢ A METRE!

MASSIVE Savings!

High specification medium duty (14/0.18) figure 8 speaker wire on 100m rolls. Ideal for hi-fi systems, extension speakers, car audio etc.

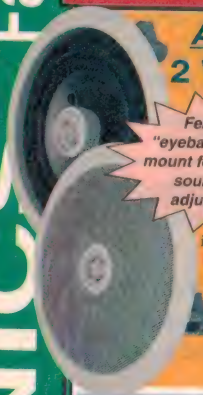
W 2105 Normally .45¢ a metre,

NOW **$25** per 100m roll,

or buy 3 rolls for **$60**

Attention Boating Enthusiasts!

2 Way Marine Speaker System



Features "eyeball" tweeter mount for optimum sound field adjustment!

Fantastic for boating enthusiasts with an ear for fine music, our Opus One Marine series coaxial system is also the answer for outdoor installations normally subject to high weather corrosion. • Sturdy PVC frame • Powder coated white aluminium grill • Polypropylene cone • Polymide tweeter is swivel mounted for high frequency focussing • Easy to install with integral swivel clamps • Massive 80W max power handling.

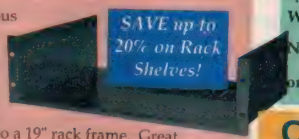
Excellent sound reproduction - definitely amongst the finest weather resistant speakers we have tested.

Sturdy PVC Frame and Aluminium Grill. Excellent outdoor speaker system!

C 0872 Normally $169 a pair,

NOW ONLY **$129** A Pair

19" Rack Shelves



SAVE up to 20% on Rack Shelves!

These ingenious rack shelves are ideal for mounting traditionally desk standing equipment into a 19" rack frame. Great for CD's, tuners, amps etc. Industrial strength black powder coat finish, includes special rear support to keep equipment in place.

Cat. No.		Useable Depth	Height	WAS	WINTER SPECIAL
H 5352	2U	340mm	76mm	$49	**$39**
H 5353	3U	340mm	120mm	$55	**$45**
H 5363	3U	400mm	120mm	$64	**$54**
H 5354	4U	340mm	164mm	$59	**$49**
H 5364	4U	400mm	164mm	$69	**$59**

Crimping Tool & FREE Wire Strippers

Bonus Strippers Valued at $22.95!

BONUS OFFER!

This professional quality crimp tool is a fantastic addition to your technical tool kit. With proper care, it will virtually last a lifetime! *FOR JULY ONLY, while stocks last, buy the T 1552 Pro Crimp Tool, and receive a set of T 1522 automatic wire strippers, valued at $22.95, FREE!* A perfect combination for alarm installers, car audio techs, auto electricians etc! Crimp tool suits red, blue and yellow size connectors. Ratchet action and all metal construction.

T 1552 Plus BONUS T 1522

ONLY **$54**

1500W Switchmode 12V / 240V Inverter

Massive 1500 Watts Output! Ideal for Remote Home Power Systems. Will Power a wide range of appliances, including Fluoro Lights & Microwaves.

This inverter provides up to a massive *1500W* of 240V power from a heavy duty 12VDC car or truck battery. Switchmode circuitry eliminates bulky and heavy output transformers, making this unit very lightweight compared to similar inverters. It's suitable for a wide range of applications such as remote homes, sail and power boats, building or mine sites, off road vehicles, caravans, farms etc.

Features: • Over temperature & overload shutdown • Auto fan cooling • Low battery warning & shutdown • Heavy duty leads • Twin outlets • Weighs only 3.6kgs

M 8140 Normally $995,

Introductory Price ONLY **$795**

SUPER SPECIAL! SAVE a HUGE $200!

Rack Frame Super Special!

Due to a slight slip-up by our metalwork supplier, these racks have incorrect side panel mounting holes. *But* since 80%/of our customers don't use/side panels on their racks frames, this could be the *bargain of the year!* For those who wish to use a panel set on these racks, they can be fitted with only a few minutes work with a drill and file, *still a massive saving!* We have *STRICTLY LIMITED* stocks of these rack frames, so *BE QUICK!*

BARGAIN! Ideal for PA racks, Hi-Fi systems, nightclubs, bands, etc

Sorry, not available from dealers!

SUPER SPECIAL!

HA5509 9 Unit Rack, Normally $159, NOW **$89**

HA5512 12 Unit Rack, Normally $169, NOW **$99**

CD Carry Wallet

Made from heavy duty fabric with internal padding, this Compact Disc carry case will keep up to 20 of your CDs organised and dust-free. Each CD has a separate protective sleeve, and the case is a fraction of the size of 20 hard cover CDs!

Keeps up to 20 CDs protected and clean in a compact, easy to carry package!

A 9250 ~~$14~~,

NOW **$9.95**

1-800 999 007 PERTH (08) 9328 1599

OVERNIGHT DELIVERY

ALTRONICS

Fax Order Line: 9328 3487

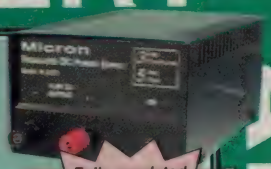
Polypropylene Speakers

These fantastic speakers are ideal for replacement speakers or your own designs. Manufactured to our own specifications, these drivers feature low Q, high efficiency and low resonance, all a must for bass-reflex bass enclosures. From the punchy 6.5" driver to the mind-blowing bass of the 15", they deliver high-end performance without the huge price tags of our competitors. Ideal for 2, 3, or 4 way systems, or as component subwoofers in home hi-fi, A/V and car audio systems.

		Watts Max	Qts	Vas Litres	Fo	Normally	This Month
C 3055	6.5" Woofer	50W	0.43	27	40Hz	$29.95	$20
C 3060	8" Woofer	100W	0.32	54	34Hz	$59	$40
C 3065	10" Woofer	100W	0.28	173	28Hz	$79	$50
C 3070	12" Woofer	150W	0.17	367	25Hz	$99	$65
C 3075	15" Woofer	200W	0.33	461	28Hz	$139	$95

SUPER SPECIAL! SAVE 30%

13.8V DC 5A Power Supply

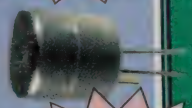


This rugged supply delivers a *regulated* 13.8V DC at up to 5A intermittent, or 3A continuous.

M 8250 Normally $110, NOW Only **$99**

Fully regulated 13.8V output! Ideal for CB's, tape recorders portable TV's etc

Electret Mic Insert *Clearout*



These electret inserts have a sensitivity of between 48 and 56dB, slightly lower than our standard C 0170 insert, which has 61dB sensitivity. They're fine for kits, FM bugs, FM radio mics, voice recorders and the like. Pick up a bundle and save *HEAPS!*

Normally $2.20 each

CX0170 Pack of 20 inserts **$10**

CX0171 Pack of 100 inserts **$39.95**

NOTE: All inserts in packs of 100 have the same sensitivity

That's only .50¢ each! Great for FM bugs, kits, digital voice recorders, etc.

Variable Temperature Soldering Iron

Excellent for professional users

Tip temperature is adjustable from 250°C to 450°C. Select the right temperature for the job and avoid heat damage to sensitive devices! Features ceramic heating element and supplied with T 2431 1.6mm conical tip. 3 other tip sizes available. See 1997/98 Cat page 111.

T 2446 Normally $49.50, NOW **$30**

Push Button Switch

We've scoop purchased these general purpose single pole momentary push button switches, and we're offering them at a ridiculous price! They're rated at 1A @ 125VAC and require a single 7mmØ mounting hole. As used in our own kit sets and products! ***Normally $1.00 each.***

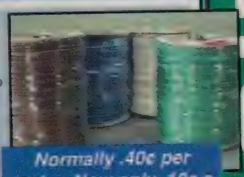
SUPER SPECIAL

SB1060 SPST Momentary Push Button

Pack of 10 Only **$4**

Pack of 100 Only **$30**

Hookup Wire



Rolls of heavy duty (24/0.20) *mains rated* hookup wire. Here's a chance to pick up some for the lab at a bargain basement price! Great for kit wiring, experimenting, auto wiring, etc. *We've even got mains colours available!* 100m rolls, rated at 300VAC, 7.5A.

VERY LIMITED STOCKS, BE QUICK!

W 0271 White
W 0273 Brown
W 0274 Green
W 0275 Blue

All **$12** per roll, OR buy one of each colour for ONLY **$40**

Normally .40¢ per metre, Now only .10¢ a metre in 100m Rolls!

TITAN Remote Car Alarm

Save 15% on a comprehensive car security system!

Easily the Best Car Alarm We Have Ever Evaluated!

Secure your vehicle with this versatile *TITAN* car security system. Don't let car thieves make off with your pride and joy, install one of these security systems and save $$$ on comparable units. System kit includes alarm module, two remote controls, battery backup siren, shock sensor, valet switch, status LED, wiring harness and hardware. *Features:* • Two remote controls • Super Loud 127dB siren • Remote panic • Battery backup and tamper proof siren • Child proofing and anti intrusion alert while driving • User selectable exit delay and auto re-arming • User selectable arming/disarming chirp • Starter kill • Valet mode • Automatic shunt of defective entry zone • Alarm memory indicates which zone (1-3) triggered • 60 second siren with auto reset • Two colour LED indicator • Can be interfaced with central locking (where fitted) • 3 extra channels on remote to control other vehicle features such as boot release, etc.

S 5205 Normally $199, NOW **$169**

3 Way Crossover *Clearance!*

SAVE 75%!

We're clearing out our 3 Way 150Watt hi-fi crossovers. Crosspoints are 800Hz and 5kHz, at 12dB per octave. Just the shot for your home-built speaker system!

HURRY! THESE WON'T LAST!

C 4009 Was $49, NOW **$15** ea

or 2 for **$25** STRICTLY Limited Quantity!

75Ω TV Coax

SAVE 60%!

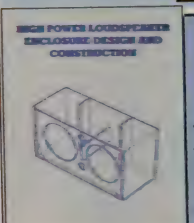
High spec 75Ω coaxial cable as used in in TV antenna installations, RF leads, test or patch leads etc. *Continuous 100m rolls.*

LIMITED STOCKS!

W 2222 Normally .90¢ a metre, NOW **$35** per 100m roll

ONLY .35¢ A METRE!

Loudspeaker Construction Book



This book includes comprehensive plans and background info for you to construct your own PA bins for DJs, bands or REALLY big hi-fi systems! The designs are used worldwide in nightclubs, concert halls, and even stadiums. This is a comprehensive reference and includes useful information on the different types of enclosures, how to obtain optimum sound distribution in a PA setup, enclosure design theory and construction, plus plans for 27 speaker designs from top-end horns to thunderous twin 15" W-bins! 166 pages.

B 2307 Normally $24.95, This Month **$19.95**

Mini Drill Set

Ideal for making one-off PCBs or prototypes!

One of the most powerful mini drills we've seen! Great for drilling PCBs, polishing, engraving, etc

A fantastic addition to any hobbyist tool kit, this powerful mini drill comes complete with a DC plugpack adaptor, four grinding stone bits, a cutting disc, four chucks (0.5, 1, 1.5, 2.4 and 3mm) and 5 PCB drills (0.5, 0.8, 1, 1.2 and 1.5mm). It's lightweight yet torquey enough to handle some really tough jobs! Great for drilling and trimming PCBs, engraving your valuables, model making, polishing gems or jewellery, custom instrument panel work etc.

T 2300 Normally $59.95, NOW **$49**

Toroidal Transformers

Save up to 60%!

We have *STRICTLY LIMITED* quantities of selected toroidal transformers available, and *they will NOT last at this price!* Great for amplifiers, power supplies, etc.

BE QUICK!

M 3080 45 + 45V 160VA	$40 ea
M 3071 35 + 35V with 15 + 15V Aux. 160VA	$40 ea
M 3088 25 + 25V 300VA	$40 ea
M 3100 40 + 40V 300VA	$40 ea
M 3120 30 + 30V 500VA	$50 ea

2MHz Digital Function & Sweep Generator

Arguably one of THE most versatile pieces of test gear, sweep generators are used to obtain the frequency response of a device eg. an amplifier on a cyclic basis, so that the waveform can be observed on a CRO. This high spec 2MHz function generator has variable sweep rate and width, and also operates as a standard waveform generator with sinusoidal, triangle and square wave outputs, all with variable DC offset and symmetry at up to 10V p-p amplitude into 50Ω. Output frequency is adjustable via a front panel dial over seven ranges. The unit also features a 2MHz 4 digit frequency counter with external BNC counter input, making it a formidable piece of test gear!

See 1997/98 Cat. p104 for details.

Features sweep & waveform generator AND a frequency counter!

Q 1560 Was $495, NOW **$445**

WINTER SPECIAL! SAVE $50

Q 0175 CRO Probe to Suit $39.95

1-800 999 007 PERTH (08) 9328 1599

ALTRONICS COMPONENTS

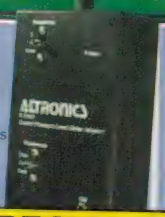
Fax Order Line: (08) 9328 3487

RF Signal Tracer Kit

(See SC June '97) When servicing AM radios or CB radios, you'll need an RF probe to trace a signal through the RF section right up to the detector. This kit, complete with screened Packtec case, combines the functions of an RF probe and a mini Bench Amp. It allows you to probe the RF circuit and listen to the signal present. It's a fantastic, low cost service tool for technicians, hobbyists and enthusiasts, and is also a great way to discover how RF circuits work. Powered by a 9V battery (not included).

K 2566 **$24.95** NEW!

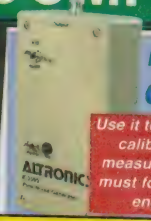
Sound Level Meter Adaptor Kit



(See SC Dec '96) This kit is a useful instrument for measuring sound intensities from 20dB to 120dB, and is plugged into a standard digital multimeter. It features A, C, and unweighted (flat) response filters, with slow, fast and peak reaction times. An ideal piece of test equipment for the audio engineer or installer. Flat response from 28Hz to 50kHz (-3db). Powered by two 9V batteries (not included). The ideal companion to the K 2592 Pink Noise Generator, which can be used to accurately calibrate the system.

K 2590 **$55**

Pink Noise Generator Kit



Use it to accurately calibrate SPL measurements! A must for the audio engineer!

SPECIAL OFFER!
To properly calibrate SPL measurements, you'll need a Pink Noise Source. *THIS MONTH*, buy both the K 2590 SPL Adaptor AND the K 2592 Pink Noise Generator kits for only **$63.95** and **SAVE 20%!**

(See Jan '97) Pink noise is used to calibrate audio systems to a particular sound level before they undergo frequency response checks eg. real time analysis, or just simply as a sound level calibration tone. Pink noise sounds like a roaring water fall, and contains a wide spectrum of audio frequencies. This kit has a 60mV output with a -60dB pad switch, and is connected to the audio system's power amplifier. Requires 9V battery (not included).

K 2592 **$24.95**

EPROM Emulator Kit

Save time and money by EMULATING your EPROM during prototyping!

(See EA Dec '95) This EPROM emulator allows you to do away with EPROM's whilst in the prototyping stage of product development. The emulator is connected to a spare parallel port on your computer and also the 'target' board. The EPROM file (that is normally downloaded into the EPROM), is then transferred into the emulator by copying the file to the parallel port. This process saves repetitively "blowing" new EPROM's with each modification to the program. Emulates 2764, 27128, 27256 and 27512 EPROM's.

As Featured in December '95 Electronics Australia

K 9530 **$149**

Remote Control Volume Kit

Control your stereo volume from the comfort of your armchair!

(See EA July '96) This kit uses an infra-red transmitter and receiver and a motor driven pot to enable you to control the volume of your amp or preamp from anywhere within 5m line-of-sight of the receiver. Build it into your home-built amplifier or preamp for a professional finish. Includes case for the remote transmitter.

K 5024 Normally $45, NOW **$39**

The SCREECHER Car Alarm Kit

A low cost but effective theft deterrent for your vehicle!

A very simple, yet effective deterrent to car theives. Controlled by a hidden switch inside your car, this alarm will sound an ear-piercing 110dB piezo siren inside your vehicle when tripped, making life very uncomfortable for anyone there! Features exit and entry delay, with a soft three second pre-warn in case you forget to deactivate it, a super bright LED warning lamp and two trigger inputs. A budget alternative to commercial car alarms!

K 4360 Normally $29.95, NOW **$24.95**

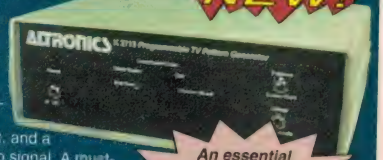
Alphanumeric LCD Module Kit

(See SC May '93) Using an alphanumeric LCD display board is not as hard as you may have thought. This kit is certainly the easiest way of learning about these devices. Simply connects straight to your printer port of your PC. Requires K 2827 software. *WINTER SPECIAL ONLY!* The K 2824 includes a *40 character by 2 line* display!

WINTER BONUS!
K 2824 Includes A Huge 40 Character by 2 Line Display!

K 2824 **$55**
K 2827 3.5" PC Software Disk $14.00

Programmable TV Pattern Generator Kit



NEW!

(See SC June/July '97) A high spec colour TV pattern generator, based on the Analog Devices AD722 RGB-to-PAL encoder and featuring an internal EPROM for storing the sync and pattern information. The standard patterns stored digitally on the EPROM supplied with the kit can be customised using a PC computer. Standard patterns are dot, crosshatch, circle, checkerboard, red raster, white raster, colour bars and greyscale bars, all meeting PAL standards. It also features direct video and RF modulated outputs with an option for an S-video output, and a provision for an input on the modulator to test the audio signal. A must-have for TV service personnel, build this invaluable piece of test gear and save $$$ on commercial units!

An essential piece of TV service gear, NOW with EPROM based digital precision!

K 2715 **$139**

ALTRONICS
174 Roe St. Perth W.A. 6000
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MAIL ORDERS C/- P.O. Box 8350
Perth Business Centre, W.A. 6849

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Standard Delivery & Packing Charge: $4.00 to 500gms, $5.50 500gms-1 kg, $8.00 1kg-5kg. Where possible we process your order the day received and despatch via Australia Post. Allow approx 9 days from day you post order to when you receive goods.

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Experimenting with Electronics

by DARREN YATES, B.Sc.

CMOS binary counters

This month, we look at CMOS binary counters and how they can form the basis of a number of useful timing circuit and waveform generator applications.

I can't quite remember where this story comes from and if I botch it up, please excuse me — but it's one worth telling. Back in the days of Roman Chariots, a wise man (he was probably from the Land of Nod) went up to the Roman Emperor and said, "Oi! How about having a game of chess with me?"

The Emperor, always one for a lark and just having conquered the Ancient World, thought he'd have a lash.

The wise man said to the Emperor, "If you win, you can have all that I have." That appealed to the Emperor's sense of fair play.

"But what if I don't win?" asked the Emperor, who wasn't quite as stupid as he looked.

The wise man scratched his head and said, "Well... Starting off with the first square on this chessboard, give me one grain of rice, then for the second, give me two. For the third, give me four and so on."

The Emperor was sure he was on a good thing and couldn't lose anyway. So off they went.

What the Emperor didn't realise was that the wise man was a chess grandmaster who had just defeated the new Roman abacus, Deepus Blueus. The Emperor was whipped comprehensively.

"Oh, well" thought the Emperor, "you win some and you lose some."

However, he wasn't aware of just how much he had lost. When it was all calculated, the Emperor had lost 2 to the power of 64 minus 1 grains of rice. Around about 1.84 x 10^{19} grains...

When the government found out what a goose the Emperor was, they called a parliamentary inquiry and gave him the boot.

The moral? If you're ever play chess with a wise man from the Land of Nod, make sure you can count in binary!

Seriously, binary counting is used in just about every area of electronics from clocks to computers and it's a good idea if you can even just understand the basics of binary counting. If nothing else, it will help with this month's topic...

TABLE 1: Binary Counting (4 bits)

Decimal	A	B	C	D
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

A lesson in counting

A few months back, we looked at the 4013 CMOS dual D-type flipflop IC. If you remember, we discovered that you could gang them together quite easily to form a chain of 'divide-by-two' outputs. You simply fed the Q-output from the previous flipflop into the clock of the next and the Q-bar output back into the D input.

Each of these Q-outputs is called a bit, since it can either be low (or zero) or high (or one). By stringing these bits together, we can create bigger and bigger numbers.

If we look at a simple example of four flipflops, the Q-outputs can be labelled A through D. Table 1 shows the basic counting mechanism and it relies on 0 and 1. Note that there are 16 possible combinations with four outputs and that with the correct weighting — i.e. the first flipflop being the least significant digit — we can count to 16 without any trouble. This can be carried on for eight bits, 16, 32 — basically as many as you want. The only problem is that when you start going up to eight and then 16 bits, trying to build a 16-bit counter using 4013s can be pretty messy.

The basics

The clever people who designed the CMOS series of ICs also recognised the benefit of having all this on a single chip. If you think about it, it's a pretty simple task. Since all of the successive clock inputs are fed from the previous outputs,

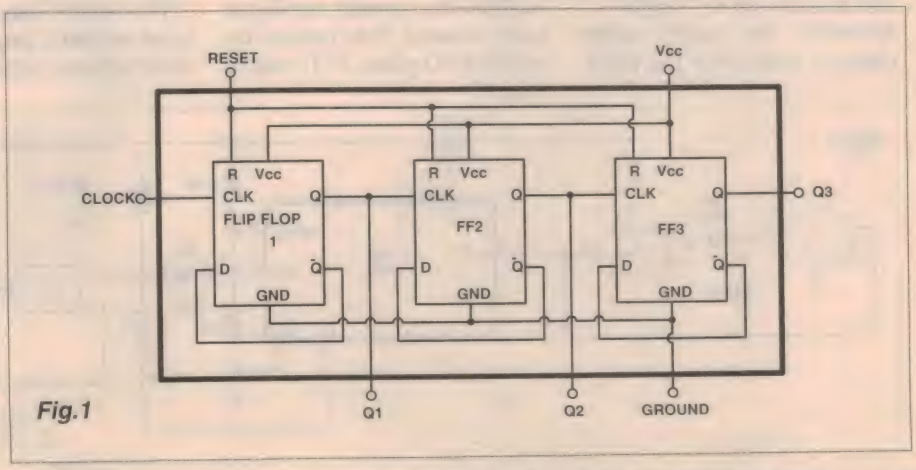


Fig.1

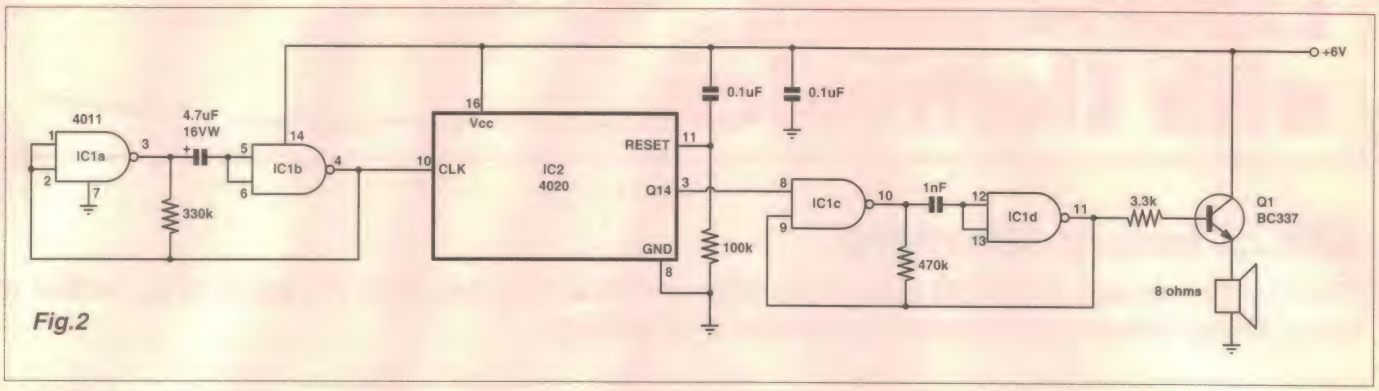


Fig.2

the only links you need to the outside world are a clock input, a reset pin to clear the count at any time, a couple of supply pins and the output 'bits'. A conceptual diagram of a simple three-stage counter is shown in Fig.1.

The CMOS design team thought this was such a good idea that they produced four chips which pretty much do the same thing, but each with their own little refinements.

Looking at them in numerical order, the 4020 is a 14-stage ripple carry binary counter; the 4024, a seven-stage; the 4040, a 12-stage; and the 4060, a 14-stage ripple carry binary counter with built-in inverters. This last IC can be made to oscillate and clock itself, while the other three require external oscillator circuitry.

In digital counter circuitry, there are two types of counters. The first is known as 'synchronous' which basically means that all of the outputs change at the same time, and the second as 'ripple' — whereby the each output changes state after the previous one. In all but the most critical circuitry, the ripple counter is sufficient. It's also cheaper to produce.

Each of the ICs just listed uses the ripple architecture. Synchronous counters are available, but because the circuitry is much more complicated to ensure that each output changes at the same instant, most of these ICs are available as four-bit counters only.

As always, the best way to learn about these ICs is to use them, so let's get into some circuitry.

Basic Timer

As you'd probably expect, since these are essentially timer ICs, we might as well start with a basic timer circuit. The circuit of a basic model is shown in Fig.2 and this is about as simple as it gets. Using a couple of NAND gates (IC1a and b) to produce the required clock pulses, IC2 counts up through its 14 stages until the last stage goes high. Once it goes high, it enables the second oscillator built around the remaining two NAND gates, IC1c and d. These then drive Q1 to make a sound via the speaker.

It's simple, it's crude and it works. As soon as the power is switched on, an RC time constant applies a short pulse to the reset pin of IC2 (pin 11) to reset the counter back to 0. This ensures that IC2 proceeds with a full count.

Because of the components used in the clock circuitry, it's virtually impossible to work out exactly how long this timer will take to time out. But we can get reasonably close. With the components shown, the clock oscillator should be turning over at about 8Hz. At each successive stage, that clock frequency is divided by two until we get to the output of the 14th stage, which has a frequency of 0.001Hz. Since we're using the 14th output as a control, we can't really count it as a divider so this gives us a divider down to the 13th stage. In time, this works out to be 512 seconds or about eight minutes or so.

The benefit here is that this is substantially longer than you could achieve repeatedly with a 555 timer. It doesn't require high-spec'd components to achieve this result, either.

Friendly alarm

The most annoying thing about this timer circuit though is its continuous tone once it triggers. Even though it's the job of an alarm to annoy the heck out of people, we can make it sound a little less annoying without adding too much circuitry.

The resulting circuit is shown in Fig.3. It relies on the fact that we can use some of the earlier outputs, combine them with the latter ones to create a beeping alarm sound that is a little kinder to the ears. It also happens to be cheaper to run as well, since the alarm isn't blaring all the time.

The trick is the use of a diode AND gate, using D1 and D2. We looked at these way back in the beginning a couple of years ago. Again, it's crude and simple but it's also cheap and it works well.

The AND gate relies on the fact that both of its inputs must be high for the output to be high. In our case, the 14th

Fig.3

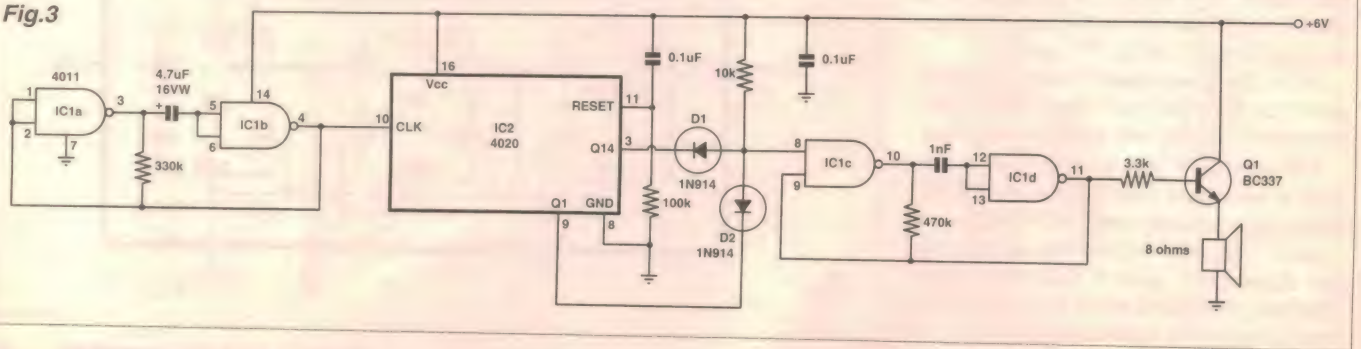
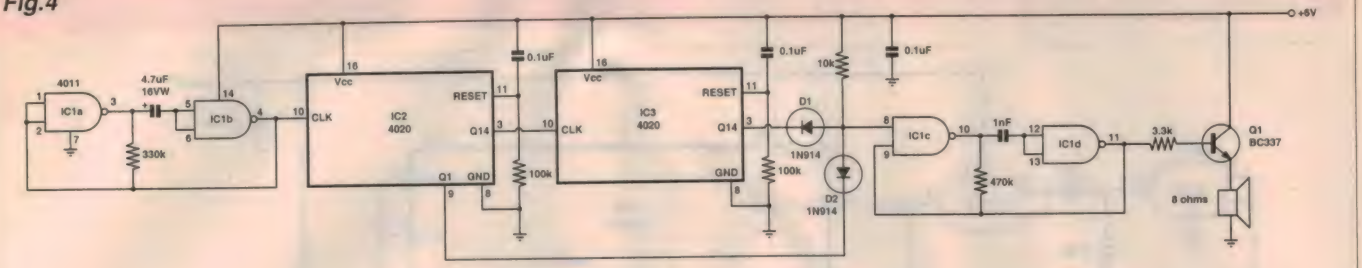


Fig.4



output is used as a control for the first output. It's really the first output that sets up or modulates the beep sound from the oscillator. The Q14 output just enables it when the time is up.

Something to remember also is that you could substitute any of the other counter ICs in this circuit. The 4024 will only give you a much shorter interval, as it only has seven stages rather than 14, but it will still work.

If you haven't spotted it already, there's nothing to stop the circuit counting once the alarm sounds. What happens is that after the next eight or so minutes are up, the alarm stops as the counter starts back at zero again.

Really long timer

As with most of the CMOS IC range, you can gang these counter ICs together as well to get some *really* long timers. The circuit in Fig.4 just adds in a second 4020 IC. If we work it out, using the same clock components as before, the time period before the alarm would sound off would be a factor of 2 to the power of 27 (14 from the first IC and 13 from the second). In normal time, that's around about 16,777,216 seconds, or about six months.

The great thing is that when you start working in binary, each stage you add doubles the length of the previous output rather than just going up in decades — so it doesn't take very long to achieve some really huge numbers.

There's a basic equivalent in computing. A computer image that is said to have an 8-bit colour depth has 256 colours. One that has 24-bit depth has over 16 million colours. Only three times the number of bits, but many more times the number of colour possibilities.

Note too that again, like most CMOS ICs, the outputs are not designed to drive light globes or 8-ohm speakers. If you want to drive anything requiring more than a sniff of current, use a driver transistor. They'll always be much cheaper than ICs.

Front porch light

The next circuit, in Fig.5, shows off how the 4040 can be used to create a very useful circuit. Most apartment blocks have a system like this, that operates a light for a couple of minutes and then automatically switches it off again.

The circuit uses a couple of NAND gates, IC1a and IC1b as an RS flipflop so that when you press the switch, the output at IC1a goes high. This enables IC1c and IC1d to start oscillating and the counter IC2 to start counting up. When the power is first switched on, IC3b provides a quick pulse to the reset pin of IC2 to ensure that its count is zero. This is pretty much guaranteed by the fact that at input from IC1a will be low on start-up, making the output of IC3b high.

When the button is pressed, the flipflop also enables NAND gates IC3a and IC3d, and allows lamp driver transistor Q1 to turn on and switch the globe on.

While the counter is counting up, the Q12 output of IC2 is low. This low is inverted by NAND gate IC3c and sent to one input of NAND gate, IC3a. The other input is fed by the same output that drives the oscillator, namely IC1a. The output of IC3a feeds another NAND gate, IC3d, connected up as an inverter. Both IC3a and IC3d together form an AND gate. You might not see it the first time but IC3d effectively 'cancels out' the inverting function of IC3a. The end result is an AND function. It may look a little long winded, but it saves us having to use extra components to create this necessary function.

Once the Q14 output of IC2 goes high, indicating the end of the timing period, the output of the inverter IC3c drops low, forcing IC3d low and switching off the globe. This same low from IC3c also feeds NAND gate IC3b which sends a pulse to the reset input to clear to counter. And further, it also pulls the reset input of the RS flipflop low. This leaves the circuit in its original condition, ready for the next person to press it.

With the oscillator components shown, the light will stay on for two minutes before turning off again.

These circular designs are always the hardest ones to understand, so go through it a couple of times until you're

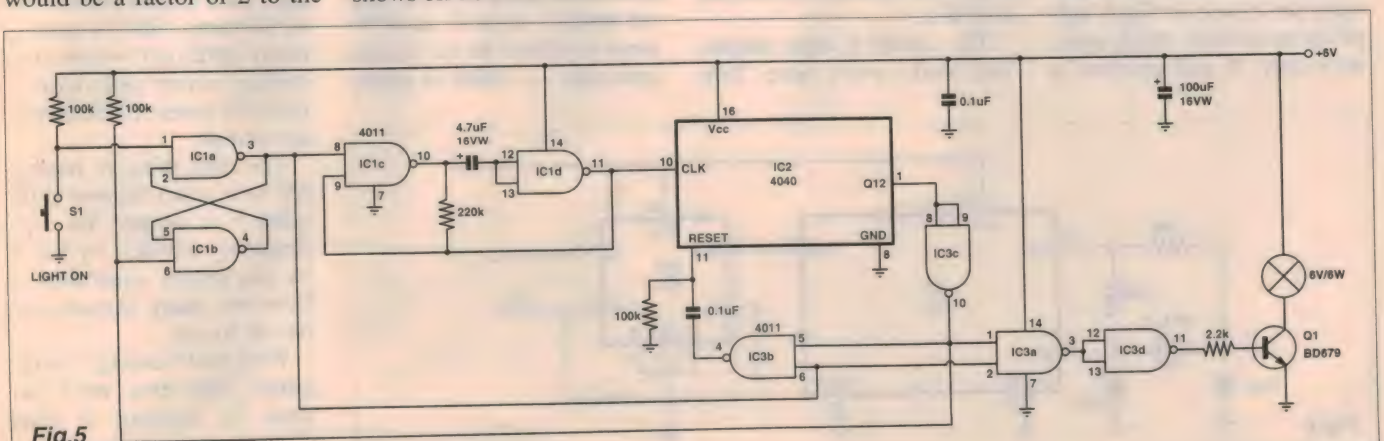


Fig.5

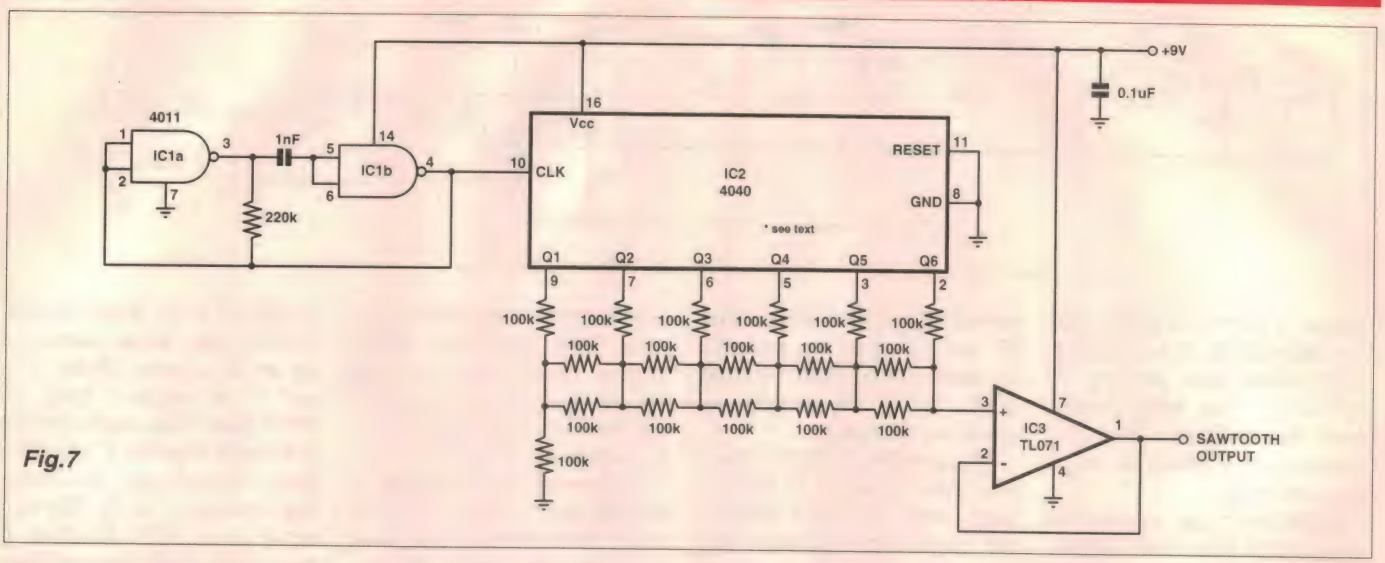


Fig.7

clear on how it all works. Better still, build it up on a breadboard using a LED instead of a 6W lamp and play around with it. If you've been following this series through, you should be starting to feel confident enough now to experiment with circuits and see what happens.

Normally, these types of circuits really control the mains supply going to a full-blown globe. But AC mains power is way beyond the scope of this column and not something we should deal with in these pages. We recommend that you should only operate your circuits from either 'plug pack' mains power supplies or batteries, for safety.

Second generator

While no circuit can make time, the circuit in Fig.6 will produces seconds. Well, more accurately, it will produce a very accurate 1Hz square-wave signal, which is ideal for testing clock circuitry.

The circuit uses a 4060 in its self-oscillating mode, and also a common 32.768kHz watch crystal. Pins 10 and 11 of IC1 are the two main controls of the built-in oscillator stage. Pin 11 is also the clock input pin. The clock input circuitry in this circuit is a common balanced-capacitance type, which gives a good if not perfect waveform to the clock input pin.

The stages of the 4060 then divide the clock signal down until it hits the 14th stage, where the output is 2Hz. A simple D-type flipflop made from a 4013 IC then does the rest, and the output at pin 1 of IC2 is exactly 1Hz. A complementary signal is available out of the Q-bar output on pin 2 of IC2.

The circuit is dead simple and works every time. You could build this up as a timing reference if you intend to spend a bit of time mucking around with timing circuits. In fact, most digital watches use a circuit strategy quite similar to this, to achieve the same division result.

Of course, you can take the other outputs of the 4060 with their different frequencies and use them as other timing references as well.

Sawtooth generator

Finally this month, we look at another of those digital-cum-analog circuits using unusual components. As we've noted before, the 4040 is the only counter IC of the three larger units that has an output for each of the stages.

This makes it ideal to use as a sawtooth wave generator. The beauty here is that we actually have 2^{12} or 4096 steps available to use in this sawtooth — which is pretty accurate, particularly for what is really a one-chip solution. However, to keep the diagram smaller (and to keep the Editor happy!), we've only shown the first six outputs. You can easily extend this out to the full 12 by following the layout.

The circuit for this is shown in Fig.7.

The only unusual element of the circuit is the resistor string connected to all of the outputs of the 4040. You may remember something similar in an analog-to-digital converter we looked at some time back. In fact, we're doing pretty much the same thing here. The idea in the ADC circuit was to create a ramp that could be used to compare a digital number with an analog voltage. This circuit creates that same ramp, that is used in many different waves from analog sweep generators to musical tones in electronic keyboards.

The only thing to remember here is that the output frequency is simply the input frequency divided by 64, or by the binary equivalent of however many outputs you decide to use.

Well, that's enough for this month. Next time, we'll continue by looking at some CMOS seven-segment display ICs. See you then. ❖

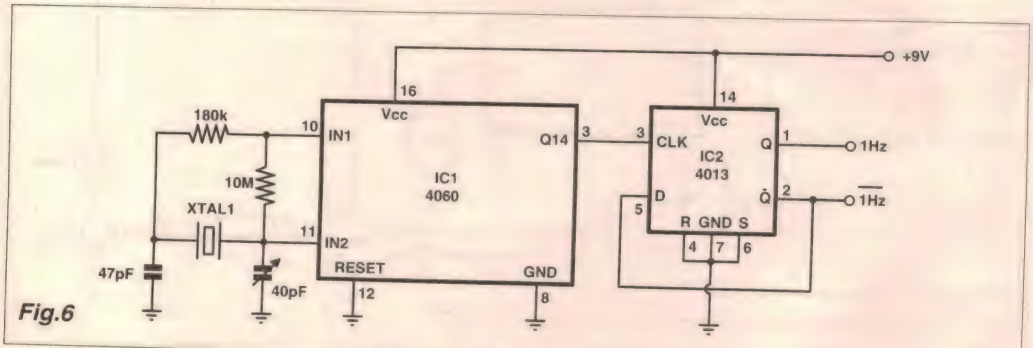


Fig.6

AUTOMOTIVE ELECTRONICS

with JON LOUGHRON Assoc. Dip. Electronics

Comparing the old and the new

This month I am going to answer a reader enquiry regarding the development of engine management/fuel injection control systems and the different directions the car manufacturers have taken regarding development of these systems. Knowing the way these systems have developed so far also helps in understanding future developments.

Recently I received a letter from read Gavin Rogers, of Duncraig in WA, who wrote:

I read with interest your article in Electronics Australia describing the functions of the CIE 8088 Automotive Meter, and it made me think about the technological innovations that went into production of older Australian cars such as my Holden Camira, which is now 13 years old. Also the main selling point of such cars, as having an 'on-board computer'.

I would be very interested to know if you plan to write an article which 'looks back' at the under-bonnet electronics that make older (simpler) cars work, compared to modern cars which seem to feature everything that opens and shuts (such as climate control and electronic displays).

A comparison between the old and the new would make very interesting reading, and would show the awesome increase in technology over the last few years. Also how the new equipment is changing the way we operate our motor vehicles, both in convenience and safety.

I hope that you will consider writing such an article.

Well Gavin, the development of the electonic fuel injection system came after a very heavy development era involving mechanical injection, which incidentally was used mainly on racing engines and very expensive European vehicles. So the advantages of an injection system fitted to a piston engine had become obvious; the only problem associated with these systems was the fact that they relied on very fine machining techniques and it was very hard to balance fuel delivery. This made it very expensive and therefore prohibitive on mass production vehicles.

Not restricted

In the early years, mass production passenger vehicles were not restricted by the emission standards that we have today because of the number of vehicles around. Carburettors delivered a practical way of providing good fuel control, and if you wanted more performance you stuck on a couple more carbys or fitted a bigger motor (the old adage was 'nothing beats bigger cubic inches'). Fuel economy was also less of a concern, because crude oil kept bubbling out of the ground everywhere.

This brings us to the old argument: which is better, fuel injection or carburetion. A lot of 'old timers' (no offence intended to anyone) would say "I remember when I could fix my XY Falcon with a piece of string and a bit of fencing wire". This may be true, but unfortunately those days are well and truly gone. You would be pushed to find a carby and a set of points on a vehicle manufactured these days — and modern vehicles have the advantage of more power, more efficiency, less maintenance and much cleaner emissions, although there is some speculation regarding the advantages of unleaded petrol.

This, by the way is not a statement regarding the benefits or shortcomings of ULP. I have not investigated the advantages or disadvantages on the above matter and just want the reader to know I am fairly neutral on this subject — frankly I regard the jury as 'still out' on the matter.

The carburettor worked very well until the EPAs of various nations decided that the emission standards were not good enough, and if nothing was done to protect the atmosphere it soon would be unbreathable. Which I personally think is a very good idea. So vehicle manufacturers started to look at ways of reducing engine emissions.

One path the Americans chose was to develop what was called a feedback carburettor. Fortunately Australia never saw many of these systems, because from what I have been told they were an absolute nightmare to service and maintain.

The efficiency of the ignition points system was reviewed because the transistor had revolutionised the electronics industry and the automotive engineers rubbed

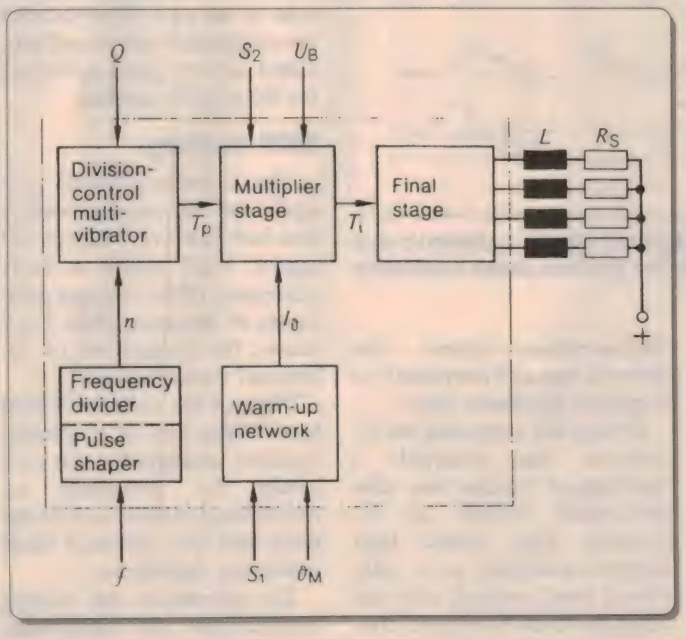


Fig.1: Block diagram of the control unit for the L-Jetronic system. (Courtesy Bosch Australia).

their hands with glee when they found a viable alternative to the mechanical switch which had retarded engine development for some time.

As I mentioned earlier, the advantages of fuel injection became obvious. The reasons for this are better atomization of the fuel and therefore a 'better burn'; also the inlet manifold can have equal lengths for each cylinder, with many twists and turns (well, a reasonable amount) because only air is travelling in the manifold — therefore wall wetting is not a problem, because the fuel injector is mounted right beside the head. The fuel and air are mixed right near the inlet valve.

of windings, and as the manifold vacuum changed the windings moved in and out to provide the ECM with an indication of the engine vacuum. The trigger for the system was quite unique as well, because there were an extra set of points located in the base of the distributor, operated like the ignition points.

The ECM was completely analog, so no fault codes were available. If any intermittant faults were evident, they were sometimes very hard to find. This unit only controlled the fuel injection, and the ignition system on this era of vehicle generally had either points with electronic assistance or a large electronic ignition module with an AC pulse trigger

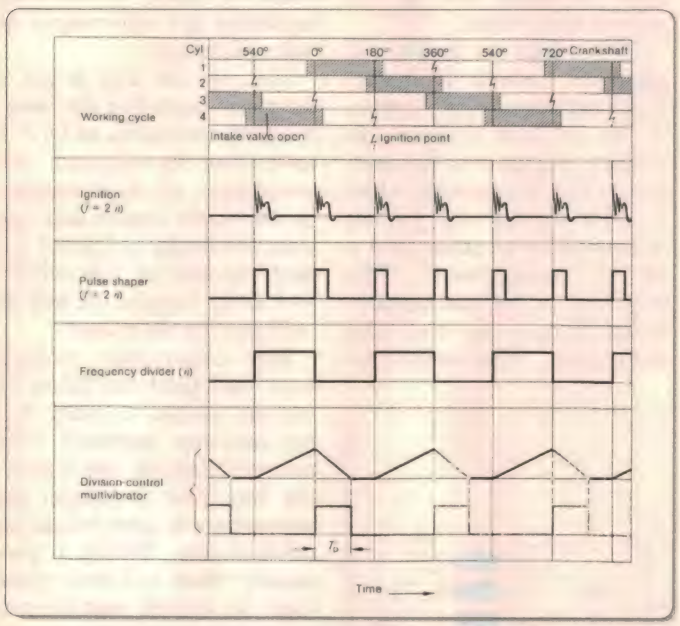


Fig.2: Pulse and waveform diagrams for the L-Jetronic system. The 'f' symbol represents the ignition pulse frequency. (Courtesy Bosch Australia)

History of EFI

A basic history of fuel injection can probably be best gained by looking at the development of the systems from Bosch.

In the early days of electronics in cars, one of the first systems developed was the D-Jetronic system. This system employed an aneroid that had a diaphragm attached to a set with no advance control — the advance was still provided by a weighted distributor plate.

During the time that the D-Jetronic was available a mechanical system was also developed known as K-Jetronic. This system later became available as a fully closed-loop network with the addition of an electronic controller, an O_2 sensor and a current-controlled actuator that allowed system pressure to be modified to ensure correct fueling for the engine. This updated version is known as KE-Jetronic and it was a very sucessful mechanical system, because it was still being used up to 1992 on some European vehicles.

The next system introduced was the L-Jetronic system, and this emerged around 1973. The reason for the change was the tremendous progress made in semiconductor technology. Hybrid technology was also available, so this made manufacturing the circuits more cost effective. When the L-Jetronic was introduced Bosch also decided to incorporate a different means of measuring engine load, and this came in the form of an air flow meter. The same unit is still seen on vehicles today. That was the main change in the system design, because Bosch established that manifold pressure is only an approximate measure of the amount of air an engine is consuming and an air flow meter provides a much better way of measuring intake air.

The trigger was also changed. It was no longer provided from the 'extra points' in the base of the distributor; these were omitted and the trigger was now derived from the negative side of the coil. This reduced the component count and provided a very good reference for the engine position.

Still analog

The L-Jetronic ECM was again of the analog variety and had some very clever circuitry. Fig.1 shows a basic schematic of the internal principles of the unit, while Fig.2 shows the breakdown of the internal waveshaping.

Most of the vehicles would have some sort of electronic ignition, and ignition advance could be provided by mechanical means such as the tried and true advance plate inside the distributor.

To rationalise the wiring connections and component count, the L-Jet system had an overhaul and became the LE Jetronic system (1981). This was the first system to appear on the Australian market, being available on the VK Commodore, JD Camira and the XF Falcon.

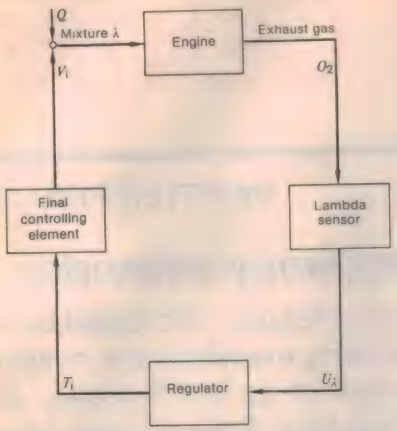
Around this time a digital control system was also released and used on the above vehicles, known as the EST system (Electronic Spark Timing). The XF and VK had either system, but not both; so if you have EST system on your vehicle and if you look under the bonnet, you will notice that the fuelling is provided by a carby.

The JD Camira fitted with the Bosch LE-Jetronic system was different from the VK and XF because it had a fuel injection system, and also an electronic advance system known as the EAI module. It may be interesting to note that the JD was also available in a different configuration, with a Delco CFI (central fuel injection) system rather than a Bosch MPI (multi point injection) system.

Some European vehicles had a system that employed a different method of measuring airflow. They employed a hot-wire air mass meter and the igniton timing was controlled by an EZK (EST) module with two controllers — one for spark and one for fuel injection.

Hot-wire air mass meters were first employed on Australian vehicles when the VL Commodore was released, and around this time Australian manufacturers then moved away from Bosch for engine management (for reasons unknown to the writer), with Ford looking to its mother company and GMH using a Nissan engine.

Bosch had been researching and developing an engine management system known as the Motronic system, which was first released on a BMW 732i in 1977. It was a combination of electronic spark technology and the L-jetronic system. (A digital version of L/LE was available, but was never installed on an Australian vehicle.)



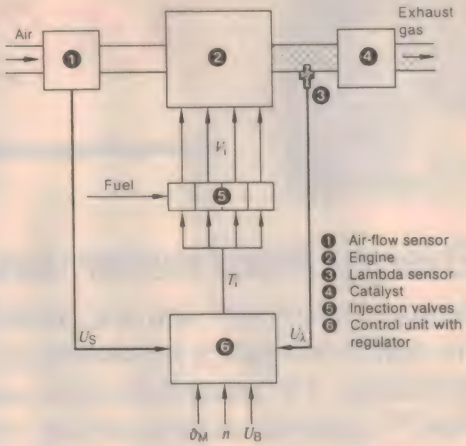


Fig.3: (a-left) A simplified schematic representation of the lambda closed-loop control system; and (b) a functional diagram of the L-Jetronic system with Lambda closed-loop control. In the latter diagram 1 is the air-flow sensor, 2 is the engine, 3 is the lambda sensor, 4 is the catalyst, 5 are the injectors and 6 is the engine control module. (Both diagrams courtesy Bosch Australia)

Digital ECM

The Motronic system was a digital system and is the basis for most injection/engine management systems available today. The Motronic system controlled injection, spark, idle speed and on later systems closed-loop control, via an O2 sensor (see Fig.3)

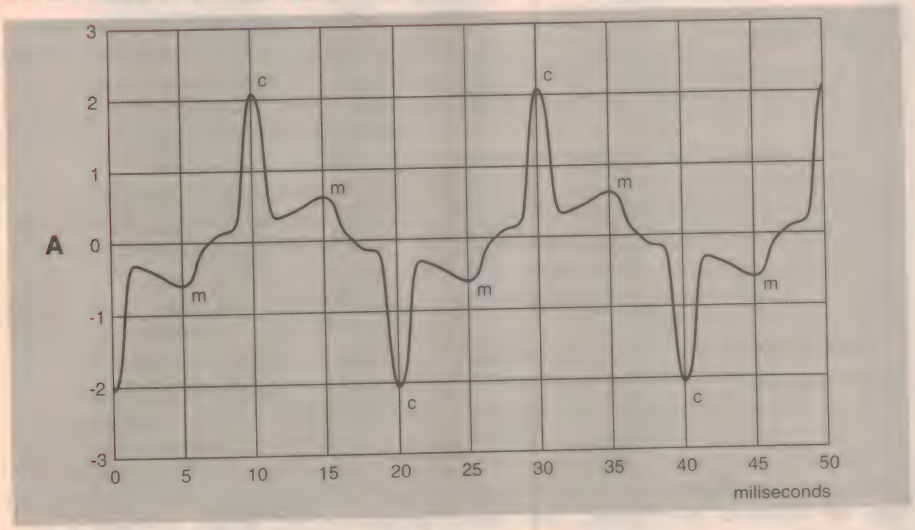
This has been only a basic overv.ew of engine control and it must be remembered that in modern vehicles the automatic transmission control has been incorporated into the engine management system. The other systems electronically controlled include climate controls, security modules, anti-lock brakes, ride height and four-wheel steering controllers, and these are sometimes all available on one vehicle. The latest unit now on the Ford 4WD has proportional traction control.

Electronics on the humble automobile has lept forward, leaving us all a little mesmerized. I'm sure that the electronics revolution is not about to be reversed, either, so the automotive engineers are not going to go back to points and carbies.

It must be also be taken into consideration that the cars we drive around today are much more comfortable and fuel efficient than before. Although this does not mean inexpensive to repair, we must take the good with the bad.

Although the comparison between late model and early model vehicles in this article has been covered only briefly, I hope it has been of interest. Needless to say some of the modern technology installed into late model vehicles will be covered in more detail, in future articles. ❖

NOTES & ERRATA



RMS Current Monitor (May 1997): Fig.1, the diagram showing the mains current waveform for a typical piece of electronic equipment, was accidentally omitted. It is reproduced here, and we apologise for the omission.

The author has also provided the following notes regarding this project:

1. Capacitor C8 may be increased to 4.7uF for greater precision with pulse trains below 100Hz. However this will increase the settling time for all readings.

2. The Analog Devices AD536AJH is available from Insight Electronics and from Farnell Electronic Components, who also stock the equivalent MX536AJH from Maxim.

3. On the PCB overlay diagram, component B2 may be replaced by two 1A diodes as shown on the circuit diagram. Connect the two anodes by bending the lead of one under the board. ❖

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INFORMATION CENTRE

by PETER PHILLIPS

Energy from water, hoaxes and a scope frequency extender

We start this month with a short story about a very expensive vacuum cleaner — followed by letters that cover topics as diverse as lightning, 'coloured boxes' for fooling the telephone network, eliminating TV advertisements, and extending the frequency range of an oscilloscope. Our What?? question is unusual too, coming from the late respected Professor Julius Sumner Miller.

I was recently assailed by a member of that most venerable of occupations: a vacuum cleaner salesman. How it came about that I welcomed into my home a guy who had the sole intention of selling me a vacuum cleaner costing nearly $3000 is another story. Recovering, I used all my trickery to throw him off the track, but in the end he convinced me to sign the papers in the sure knowledge I could 'terminate the agreement' within 10 days.

I lay awake that night, pondering my pending ownership of a vacuum cleaner worth more than my wife's car! I also pondered the operation of the machine, and decided that the claims made about it should be tested. Sure, it had been a convincing demo. You probably know the one where you're invited to clean a patch of carpet with your (old!) cleaner, at least 15 times please. Then you stand appalled at the amount of dirt the Super Sucker gets out!

I finally decided before going to sleep that even if it was going to 'prolong my life' (a claim that was made), there was no way I was going ahead with this. But I still decided to see just how much better it was than our three months old Wertheimer 140, costing $449.

The next day I measured the vacuum at the nozzle under controlled air flow conditions for both machines, and found mine to be 20% better. I then conducted tests on the ability of the two to pick up dirt, including one test where each machine cleaned a section of carpet, bags replaced, then repeat the same area, but swap the machines. The results showed the machines were about equal, with the Wertheimer slightly better. There was more, but by now I was getting angry.

You can probably get my drift. Here am I, a mature, intelligent person who had almost been conned into spending a ridiculous amount of money on a vacuum cleaner no better than a $449 machine. So, although you might think you're less vulnerable than me, be warned: after the convincing demo they pull out the health factor, the much reduced work factor, the savings in carpet cleaning costs, all backed up with 'university' research. So it's not difficult to get sucked in.

I documented my results into a report — figures, calculations and all — and sent it, along with the terminating agreement documentation, to the company selling the machine. The response was immediate, and the salesman returned to pick up the machine, but not without further attempts to convince me of its virtues. Needless to say, they fell on deaf ears. Oh sorry, no pun intended at the end of the previous paragraph.

Now to our first letter...

Lightning

We've had letters about lightning in this column before, but this one got me thinking:

I recently saw a TV program on lightning, and was amazed to find that the current of a typical lighting bolt is 10,000A or more. The program didn't give the voltage of the strike, but given the immense distance the strike travels, I guess a million volts is on the conservative side.

Multiplying the current by the voltage to get the energy contained in the strike gives 10,000MJ, lasting typically around half a second. If you divide this by 7200 to get power for one hour, the result is still more than a megawatt. Surely this energy can be captured and stored. Are you aware of any research in this area? It seems like energy begging to be used. (Don Morgan, Chatswood, NSW)

When I read your letter Don, I began to think that while capturing lightning and storing its energy might be an obvious thing to do, perhaps this type of research is not the way to go. Instead, it might be more fruitful to discover the *mechanism* that produces this energy, from (it seems) nothing more than water, air and turbulence...

The more I thought about it, the more I began to wonder where this energy is coming from. After all, energy cannot be created, it can only be transformed from one form to another. While there's no doubt a storm requires energy to lift the water from the ground, and more energy to create the turbulence, there doesn't seem to be enough of it to account for the massive quantities of electrical energy released by a storm. Let's face it, we're talking about gigawatts when you add up the number of lightning strikes that occur in the average storm.

I then remembered seeing a TV program that showed two isolated examples of research into releasing the energy contained in water. Yes, water! It seems some people think water contains energy that is just waiting to be released, so I wonder if a thunderstorm has the secret ingredients to do just this.

Of course this raises the question that if water contains energy, then it must eventually all be transformed into another form, and we'll run out of water. As thunderstorms have been going on for millions of years, and there's no indication that our water stocks are becoming depleted, perhaps there's more to it. For instance, could there be a mechanism in which water stores energy, like a capacitor? When the energy is released, the water is then 'recharged'. I know it all seems fanciful, so my question to anyone who might know is: where does the energy come from in a thunderstorm?

(*Ed: Here's my guess — the Sun.*)

UTC clock

The next letter seeks information on a clock that can be used with a shortwave radio. I'll let the writer explain.

I'm a shortwave radio listener who persists in using several high quality, older radios which while 'digitally tuned', do

not have the built-in digital 24 hour (UTC) clock found on later models. This clock is generally built into the display.

For some time I have been seeking a circuit for a digital clock with these features: a choice of 12 or 24 hour modes, two readouts (one for UTC and one for local time), and the ability to switch a radio or recorder on or off at certain preset times. I'd appreciate it if you or a reader could indicate where a suitable circuit might be found. I have in mind something like the Kenwood HC-10 clock, which is no longer available. (Sam Powrie, Semaphore, SA)

We haven't done a clock project for many years, Sam. The most recent I could find is a 24-hour Crystal Clock project we presented in December '81. However, I can't locate a copy of the article, so I can't even tell you if it would help.

The device you seek seems simple enough, although the two displays and the load switching relays might make it more complex than your average digital clock. Sorry that we can't help you, but perhaps another reader can.

DTMF hoax

In May I presented a letter from a young reader seeking information about an oscillator with some quite tight timing requirements. As I like to help younger readers as much as possible, I developed a basic circuit and described it in the column. But according to the next letter, perhaps our young reader has a less-than-innocent use for the oscillator.

In the May issue you presented a letter from a New Zealand reader asking about a 'complex oscillator'. It seems to me that Mr MacIntosh is after a dual-tone multi-frequency (DTMF) generator.

Moreover, the timing requirements he specified suggest that he has fallen dupe to a 'hacker's coloured box' — the name given to a mechanism for fooling the telephone network into providing free phone calls. In the past, the public switched telephone network (PSTN) call control and billing systems used what is known as 'in-band' signalling. It used special DTMF tones (which are carried within the audio band) to send these call control signals.

The various coloured boxes were designed to fake these control signals, in essence to 'pretend' that the user was a telphone company operator or exchange. Of course they don't work anymore, as a modern PSTN uses a separate data network for the signalling system, which is inaccessible to the home user. (Ben Low, via email)

Hmmm — interesting, Ben. At the time when I was thinking about this oscillator, the first thing I did was look up the DTMF frequencies allocated to the keypad of a phone. As those specified were different, I assumed the oscillator had nothing to do with telephony, although I certainly wondered what it's use might be. But from what you say, there are quite a few more DTMF tones used in telephony.

So it seems our young reader may be fiddling about with 555 timers in an attempt to get free phone calls. As you say Ben, he's doomed to failure, but at least he'll know more about electronics by the time he has finished. So there's something good in it after all.

Incidentally, if you're wondering what is meant by a 'coloured box', it appears to be a way of identifying a circuit for illegal use with the PSTN. Ben sent me a list of some he had found on the Net. For example, a 'chartreuse box' is a way of using the electricity from your phone line, and a 'blotto box' shorts every phone in the immediate area. In fact, some of the boxes are downright subversive, like the 'mauve box' that provides a phone tap without cutting into a line. Fortunately, it seems these 'boxes' represent a wish list, as most are impractical. But it makes you wonder.

TV ad eliminator

The next letter follows on from our discussion in the April issue about cutting out advertisements from a TV program. According to the next letter, there *is* such a device:

I read with interest the short article about a TV advert eliminator. Such a device does exist, as I have seen one demonstrated. In the early 1980s we lived in Arkansas in the US, and these devices were on sale, either built into a video recorder, or as an extra you could add. I nearly bought one, but as we didn't have a VCR at the time, there was no point. According to the salesman, it works like this.

TV stations like to attract the attention of viewers when there's an advertisement. In the US, the law prohibits stations increasing the volume during an advertisement, but there is no law against increasing the amplitude of the transmission. This, according to the salesman, is why ads are always brighter and louder than programs. The ad eliminator monitors the signal level, and when this level increases, it pauses the VCR via its remote control. When the signal drops back to normal, the VCR is started again.

I remember a combined VCR-TV unit that had this feature built in. It also used some sort of endless video tape that allowed the viewer to replay a part of the recorded action at will. I can't remember if this meant losing some of the recording while the VCR was playing back, but I think it was claimed you could watch part of the recording during the recording process. Unfortunately I never saw this unit operating. I hope this sheds some light on the topic, and perhaps it might spawn a project. (Robert Rose, Dural, NSW)

I'm tempted to say it could only happen in America, the birthplace of many wondrous gadgets. Although you have seen an actual device Robert, I am not convinced

it has much of a future. You say you saw it work at the time, but surely advertisers would soon wake up to what's going on, and ask stations NOT to increase their transmission amplitude?

As well, using the carrier amplitude to provide a switching signal has many problems. For starters, it's unlikely that any two locations receive at the TV antenna terminals the same level of carrier. There are so many variables, such as the type of aerial or aerial cable, the length of the cable, the signal strength at the antenna and so on.

But let's say you can adjust the eliminator to compensate for this. What happens when it rains, or when a plane interferes with the signal? Or what about when the overall carrier level changes with the video content? I cannot see how such a device can be reliable. Missing out on the end of a movie because a plane flew over would annoy me far more than watching the advertisements.

So I guess I'm not convinced that this device is practical. But here's another letter on the subject:

A couple of years ago, a person I once worked for popped up on the news, having developed and patented a device for ad 'zapping'. Since then I've heard nothing. I thought at the time it was a strange thing for him to be doing.

I suspect it was a revenue raising ruse, as anyone who develops such a device will probably find themselves receiving cheques from lawyers wanting to prevent such a device becoming a reality. (Chris Johnson Walker, Whiporie, NSW)

It seems a rather difficult kind of 'revenue raising ruse', Chris. Surely the lawyers would want proof that the device actually worked. You'll notice that I've not identified the person you mentioned in your letter. However I can say the company Chris worked for was well known, and technically ahead of its time.

So, ruse or real? We'll probably never know. But there's one thing you can be sure of, if someone does develop a reliable ad 'zapper', our erstwhile advertisers will change the rules to beat it. Let's hope the ABC continues to remain ad-free!

Scope extender

You might recall some time ago I included a letter from a reader new to electronics, seeking advice about a device that would allow his low bandwidth scope to show signals well outside its frequency range. I explained that the usual method of doing this with an RF carrier is to down convert it, that is to change the carrier frequency while still retaining the modulation. This is done in all radios and TV sets, and can be done with a scope as well.

However I had forgotten about the method described in the following letter. It's probably out of fashion now, but it might be the basis of the device the reader described as being available in the US:

There is a method of periodic signal processing to lower its frequency that goes back to the days when scopes had a bandwidth of no more than 20 or 30MHz. It uses a stroboscopic effect by sampling the input signal with a frequency slightly lower than the input signal. It's a variation of the sample and hold technique, in which the sampling frequency is synchronised with the frequency of the input signal.

When the sampling frequency is 1% lower than the input frequency, it gives one sample from each cycle of the input signal, but delayed in phase by 3.6°. The train of samples is then passed through a low pass filter.

If the input signal is periodic (same for each cycle), the output voltage from the circuit has much the same shape as the input, but the frequency is 100 times lower. This is shown in Fig.1, although for clarity, the sampling frequency is 20% lower than the frequency of the input.

The limitation with this method is it won't pick up transients or events that occur at irregular intervals. But it does give an enormous increase in the range of frequencies that can be displayed. For example, back in the 60s, I owned a Polish oscilloscope model OSA 601 that had a bandwidth of 60MHz, with the inbuilt stroboscopic block increasing this bandwidth to a few GHz.

Building this circuit is probably beyond the hobbyist, as it uses special ICs, and requires excellent stability. I also doubt if it is available commercially, as today's scopes have a much wider bandwidth and don't need this enhancement. (Marcin Frankowski, Wellington, NZ)

Thanks for this information, Marcin. I remember seeing a similar device some years ago, but I can't remember seeing it in operation. Still it's interesting in these days of sampling digital oscilloscopes to realise the technology goes back quite a way. Incidentally, if the sampling frequency in Fig.1 is increased, the output waveform will be a better replica of the input.

Beta tapes

In May I responded to a reader's enquiry about the availablity of Beta video tapes, saying these are now rather hard to come by. But:

I own two Beta video recorders, and can tell you that Sony brand Beta cassettes are available from Tandy and Dick Smith, but perhaps not at smaller stores. (B. Holcombe)

So, they are still around, which is good to know if you own a Beta machine. Thanks, Mr Holcombe.

68HC11 microcontroller

I've received a number of letters about the availability and virtues of the Motorola 68HC11 microcontroller, as opposed to the better known 68HC05 family. The first deals with purchasing a 'HC11:

I noticed in the March edition a letter from a reader (Rob Moulis, Hackett, ACT) asking about suppliers of the 'HC11 chips for use in a robot. They are available from RS Components and, I suspect, from Farnell. In fact, the most difficult to get parts are the support chips, and of course the various sensors needed for a robot. A good source for motors and gearheads is Ernie Australia.

By the way, for someone into robotics, another great book and kit is the The Muscle Wires Project Book and deluxe kit, which deals with the amazing field of shape-memory alloys. The most interesting project is Boris, a motorless six legged walking robot controlled by a BASIC computer program. It won a gold medal at the BEAM robot Olympics. Mondotronics also carries 'bot boards' for the 68HC11, as well as RAM etc. (Roger Close, Mulgrave, Vic)

Robot Olympics! Now that's something I've never heard of. The mind boggles at what these robots have to do, to win a 'medal'. Still, it's surely an excellent way to promote the technology. Thanks for your letter Roger, and for telling us about Boris.

The next letter came to us via email, and the author acknowledges that it 'rambles a little'. I've had to do quite a bit of pruning, but hopefully I've not cut out any of the important bits. It gives an excellent comparison of the HC05 family versus the HC11 family:

Regarding your discussion on the 68HC05 versus the 68HC11, I want to point out that these are families, and within each family there are a wide range of different microcontrollers,

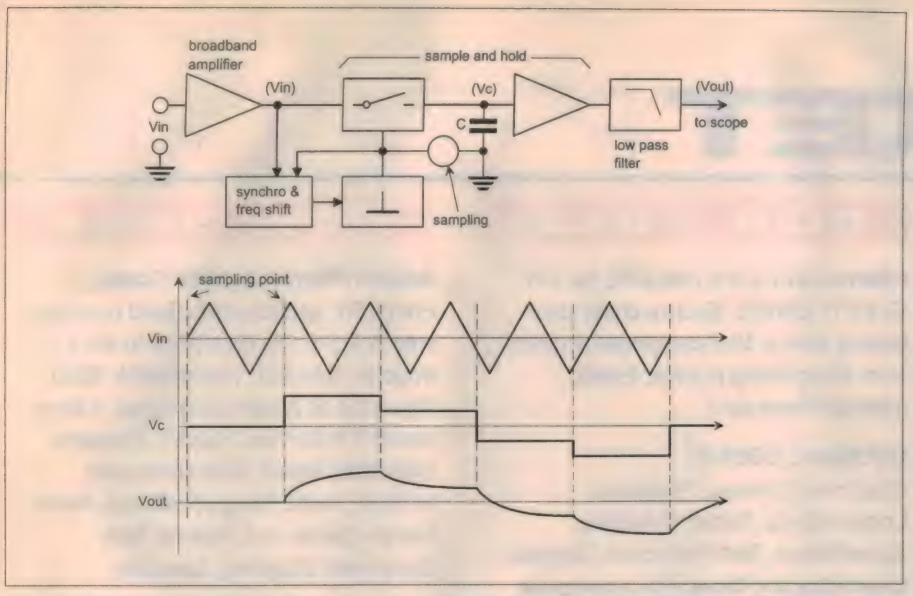

Fig.1: The basic circuit for a device to display HF signals on a limited-bandwidth scope, as suggested by Mr Frankowski. It uses sampling at slightly lower than the input frequency, to perform frequency downconversion.

ranging from the simple HC05Jx series to the HC11Nx or PH8 series. Although the HC05 family members share the same basic instruction set and processing core, they have no single defined common family features, other than the simple ones, such as the COP (watch dog), and free running timer.

The HC05K1 has no extra features, other than an external interrupt pin, and is a 16 pin device, with 32 bytes of RAM, 10 I/Opins, and 504 bytes of program ROM. This is the low end of the family.

The HC05C8 probably represents the middle ground for the HC05 family. It has 24 I/O pins, and seven input only pins, an interrupt, an SCI, an SPI, one capture input, one compare output (explained later), 176 to 304 bytes of RAM, and 7744 bytes of program ROM.

The larger family members include the F8, which is optimised for cordless telephone applications, the L28, which includes LCD backplane driver circuitry, and the E0, which has a 64K external memory bus.

The devices in the HC11 family on the other hand are extremely feature rich, which is the reason for their popularity. All members of the family, except perhaps the 'D' series, (of which I'm not familiar), have three or four input capture pins, four to five output compare pins, an eight-channel eight bit A/D converter, SCI (RS-232), SPI (3-wire serial), 192 bytes to 2K bytes of RAM, and 256 to 2KB of EEROM.

Capture and compare timers are hardware circuits which, in the case of a capture circuit, stores the internal timer value when the capture pin changes state, and optionally generates an interrupt. These pins can be programmed to detect rising or falling edges, and may be software altered. This enables quite accurate timing (to within 250 nanoseconds on some devices) of pulses, frequences, and other external events. These might typically be used to time the engine speed of a vehicle, in engine management computers.

The compare circuit is the opposite and allows the programmer to generate pulses or signal changes at precisely timed intervals, such as the firing signal for a fuel injector. The large number of timer sub-circuits on the HC11 family makes these devices well suited to automotive applications, amongst many others.

The basic family members are the A, E and D series. The D series is not particularly common, with the A and E series being the most commonly used. These devices are essentially pin compatible, with the exception that the E series has a user selectable extra capture or compare pin, which, on the A series is always an output compare. The family members are the E/A0, with no ROM or EEROM, the E/A1 with no ROM but 512 bytes of EEROM, the E2 with no ROM but 2KB of EEROM, which can be used for program or data, and can be programmed in system. The A8 has 8K ROM and 512 bytes of EEROM, the E9 has 512 bytes EEROM and 12KB of ROM, and the E20 comes with 20K bytes of ROM and 512 bytes of EEROM. All family members have between 256 and 512 bytes of RAM. (Alan Cook, via email)

Sorry Alan, that's all the space I have for now. Alan also points out that these devices are available from Motorola appointed distributors, including Veltek and AVNET EMG (formerly VSI). These companies have offices in most major cities but are geared to service the professional developer, and not the hobbyist. Alan's letter also discusses prices and other aspects of the two families. I'll try and include some more of his letter next month.

What!?

As I'm running very low on reader contributed What?? questions, I'm presenting one from an old book (1966) in my collection, written by Professor Julius Sumner Miller. Remember him? He was a formative person in my life, as I'm sure he was for many, with his confounding questions that generally had a simple answer.

Most of the questions in the book deal with physics, but the one I've chosen has an electronic feel to it, on the basis that it deals with wavelength. I'm presenting the question as it's written in the book, to capture the professor's quirky and entertaining writing style.

A water wave in the sea — the ocean — having a certain wavelength has a certain velocity. The wavelength is the distance between any two consecutive points in the same phase — that is, for simplicity, the distance, say, between successive peaks or humps. So this wave has a very fixed speed. Suppose the sea was now a sea of mercury. What do you think about the speed of the wave now?

Answer to June's What?

The cosine of angle theta is 0.5, so theta 1 and theta 2 both equal 60°. AB is obviously one side of an equilateral triangle which can be inscribed in the circle. Hence the area of the sector ACBO is one third the area of the circle ($1/3 \times \pi \times 4 \times 4$) which equals 16.755. The area of the triangle AOB is $2 \times \sqrt{(16-4)} = 6.928$ (by Pythagoras). Therefore the required area is $16.755 - 6.928 = 9.827$. ❖

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http://www.oztechnics.com.au/

Large Quantity of old Electronic Test Equipment. Meters, tuners, valves, capacitors, resistors, radios, microphones, magazines, technical books, etc. Ring or call at **Brookvale Bazaar**, 505 Pittwater Road, Brookvale NSW. Tel (03) 9905 0384. **Open 7 days**

WANTED

Wanted: Sharp PC1600
(not PC 1500) Pocket Computer for special application. We will pay $300 for a good unit complete with Ramcards. Phone Tom or Murray (02) 9584 2639 (Business hours). We will pickup unit anywhere in Sydney.

SPECS IN SECS: IC DATA ON THE INTERNET

Much of the Internet is hype, noise and a good portion of rubbish. But in amongst this, there are some great reference sites. It's also possible nowadays to download free datasheets, from over 40 major semiconductor manufacturers including National Semiconductor, Motorola and SGS-Thomson.

by DARREN YATES

Like most of the forms of media we know, the potential of the Internet is still fairly much unrealised. While it has become the hangout of those addicted to chat lines and games, and the greatest excuse for the marketers who don't reach their advertising targets, there are a comparative handful of sites which contain a veritable goldmine of information for the electronics engineer and the hobbyist alike.

As I have often said in my 'Experimenting with Electronics' column, having specifications of ICs on tap not only makes it easier to stay up to date, it makes it easier to learn.

When I started thinking about designing my own circuits around 10 years ago, the only way you could figure out exactly how an IC worked was to buy complete sets of databooks. You only needed to collect the set of National Semiconductor's linear volumes, the CMOS databook, a few from Texas Instruments and you'd fill up a shelf in quick time.

I still remember looking down the long rows of Philips databooks in the library at Macquarie University. And they weren't cheap either — just tooling up with a basic set of books could cost you well over $300. For a large company, that's an easy tax deduction; but for the individual, it was a pretty big expense.

Luckily, that's now all changed.

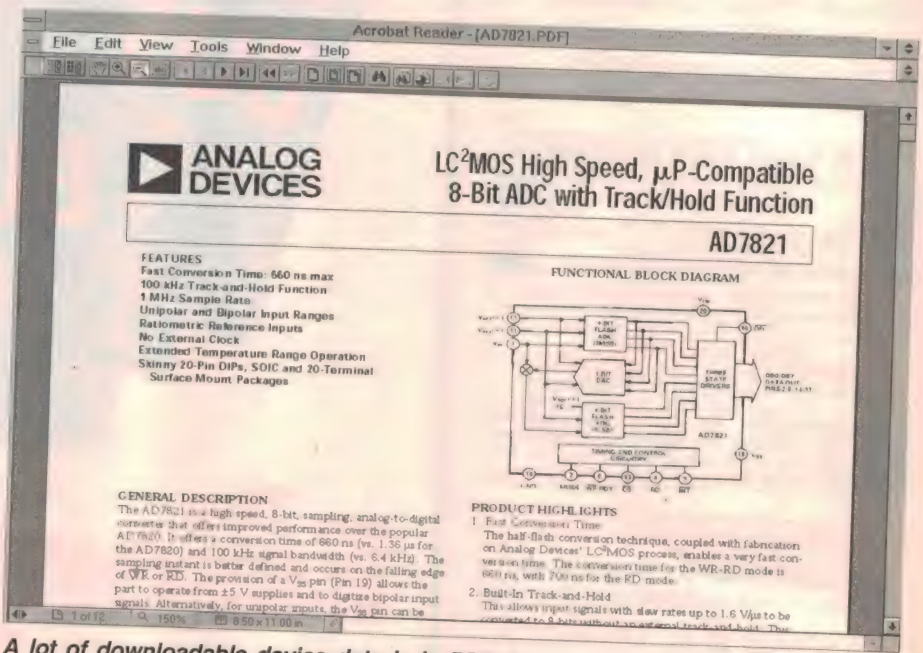
Internet resources

Rather than considering the Internet a 'pleb tool for the masses', engineers can now really make full use of the Internet as a resource. In just a short time, I managed to find over 40 semiconductor manufacturers who have their datasheet database on-line free of charge.

Companies such as National Semiconductor, Philips, Motorola and SGS-Thomson now have many, many of the ICs on their books online.

While a number of the smaller companies want you to 'register' before they'll let you rummage through their library, this usually only requires a name, address and an email contact address. For that amount of free info, it's not so much of a worry. If it does worry you, only a small number of sites are worrying about this and usually just to get you on their mailing list.

The four sites I've just mentioned are all anonymous and free from any registration — just go in and have a look for what you want.



A lot of downloadable device data is in PDF format, which can be viewed and/or printed out using Adobe's Acrobat Reader — itself freely available for downloading.

PDF files?

The only problem with the Internet is that HTML or Hypertext Markup Language, as used for Web pages, is not very conducive to producing datasheets as you'd normally expect to see them. Happily Adobe, makers of software such as Photoshop and PageMaker, saw a real need for a simple but effective electronic book publishing application which would make it easier to create electronic documents with a rich graphics/text mix. The result was Adobe Acrobat, and many of the semiconductor companies on the net are using this as a defacto standard for reading datasheets. That's why most of the datasheets download as '.PDF' files, which are displayed and printed out using Adobe's *Acrobat Reader* application.

The results are excellent. Acrobat Reader is easy to use, with print and zoom capabilities so that you can get closeups of tables or images as well as being able to print them out on paper.

I had a quick run through printing out a couple of National Semiconductor datasheets, and even if you only have a 300dpi inkjet printer, the results are great. On a laser printer, you'd be hard pressed to tell the difference between it and the original published work.

But the best thing is that Adobe has made Acrobat Reader available free of charge, from their web site at **www.adobe.com**. Simply log on and download the self-installing program.

The reader occupies around 5MB of space on your hard disk drive and you'll need Windows 95 to use the latest version (V3.0). If you're running Windows 3.11, there are older 16-bit versions

which you can obtain from various shareware sites. Remember this is only a reader — if you want to create your own electronic books, you'll need to buy the complete Acrobat suite.

When you're browsing through the web sites, any file with the extension PDF is an Acrobat file which can be read by your newly-installed reader.

The size of the PDF files can vary depending on the length of the datasheet, from as little as 80KB for discrete components to up to around 1MB for larger function-specific ICs.

The obvious bonus of all this is that you don't need to be on-line every time you want to look up an IC. If you've downloaded the PDF file, you just start up Acrobat Reader and look for that particular file.

Just a word of warning: not all manufacturers have given self-explanatory file names to their PDF files. But you can quite easily rename the files once you've downloaded them, to turn them into something more meaningful.

Download times will depend on your Internet Service Provider (ISP) and where the info has to come from. Unfortunately none of the sites is located here in Australia; most are either in Asia or the USA.

The sites

The list in Table 1 is by no means exhaustive, but it contains most of the top 50 semiconductor manufacturers from around the world.

Unfortunately, some of the more commercial Web sites such as those of Samsung, Intel and AMD can be a little difficult to navigate, with plenty of corporate advertising that can only be described as being 'in your face' from the word go.

To load up a site, simply type the URL line that appears next to each company in your web browser's address line, and hit 'Go'. Where possible, I've given you the link as close to the information as possible. Some companies give you a complete alphanumeric list in one section while others split up their devices into separate categories. Where possible, I've taken you to the last step before this categorisation.

The more accommodating sites will also have application notes on-line, so that you can use their circuit examples to get yourself up and running.

Some sites are also more difficult to hop on to than others. For example, I had great difficulty hitting the International Rectifier site. There are times in the life of every Web site when the site has to come down for periodic maintenance. Usually this lasts no longer than an hour or so, so give it a rest and come back to it later. The great thing though is that most semiconductor sites are not the most popular, which means on the whole you're should never get a 'server too busy' message.

Not all sites are willing to give you the same amount of info. The Intel site, while being quite flash with lots of downloadable software, contains precious little real information about their chips — which I guess in the light of AMD and Cyrix breathing down their neck, one can understand.

For the hobbyist, the National Semiconductor and SGS-Thomson sites have a wide range of information, with SGS-Thomson having one of the most complete references to the 4000 CMOS family.

There are also sites with plenty of FET and standard bipolar junction transistor datasheets, as well as specialist sites such as International Storage Devices with their range of voice recorder ICs.

Most sites also have dealership information, so that provided you can purchase enough quantities, you should be able to get the IC you want.

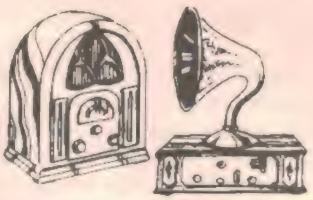
Whatever your fancy, the Internet has some excellent sites — whether you're interested in designing your own circuit as a hobby, or if you're chief engineer for a large corporation. Device datasheets are now easier to get than ever before! ❖

TABLE 1: Semiconductor Manufacturers on the Web

Company	URL Address (precede with http://)
Advanced Micro Devices	www.amd.com/products/products.html
Advanced Power Technology	www.advancedpower.com/
Analog Devices	www.analog.com/products/index/index.html
Apex Microtechnology	www.teamapex.com/data_sheets.html
Burr-Brown Corp	www.burr-brown.com/Products/Products.html
Cyrix	www.cyrix.com/
Dallas Semiconductor	www.dalsemi.com/DocControl/index.html
EXAR Corp	www.exar.com/products/prodalph.htm
GEC-Plessey	www.gpsemi.com/products/proddata.htm
Harris Semiconductor	www.semi.harris.com/
Hitachi	www.halsp.hitachi.com/
Information Storage Devices	www.isd.com/product/prodinfo.htm
Integrated Device Technology	www.idt.com/corpinfo/products.html
Intel	www.intel.com/intel/product/index.htm
International Rectifier	www.irf.com/product-info/datasheets.htm
Lattice Semiconductor	www.latticesemi.com/cgi-bin/lattice_list_files
Linear Technology	www.linear-tech.com/prodinfo/
LSI Logic	www.lsilogic.com/cgi-bin/ll_step1_tech
Maxim	206.65.84.190/
MicroSemi Corporation	www.microsemi.com/products/PRODUCTS.HTM
MIPS Technologies	www.sgi.com/MIPS/products/index.html
Mitel Semiconductor	www.semicon.mitel.com/Products.html
Motorola	motserv.indirect.com/sps/General/chips.html
Music Semiconductor	swww.music.com/mu9c3480a.pdf
National Semiconductor	www.national.com/design/index.html
NEC Semiconductor	www.ic.nec.co.jp/english/products/index.html
Oki Semiconductor	www.okisemi.com/public/nt/Products.html
Opti	www.opti.com/support/products/931.htm
Philips Semiconductor	www.semiconductors.philips.com/designerindex/
PowerTech	www.Power-Tech.com/index1.htm
Samsung Semiconductor	www.sec.samsung.com/
SGS-Thomson	www.st.com/stonline/books/pdf/menu/bookshop.htm
Siemens	www.sci.siemens.com/cgi-win/wincgi.exe
Simtek	www.simtek.com/simtek/docs/ProductList.html
Sony	www.sel.sony.com/semi/pdctguid.html
TDK Semiconductor	www.tsc.tdk.com/
TEMIC Semiconductors	www.temic.de/products.html
Texas Instruments	www.ti.com/sc/docs/schome.htm
Toshiba	www.toshiba.com/taec/components/family/family.html
Unitrode	www.unitrode.com/prods.htm
Xicor	www.xicor.com/xicor/menulink/link3.htm
Zetex Semiconductors	www.zetex.com/guides.html
Zilog	www.zilog.com/products.html

Vintage Radio

by ROGER JOHNSON



The Fisk Radiola 257: 'Big is beautiful'

AWA's Fisk Radiola model 257 for 1937 had the latest in everything. It was big and expensive, but a brilliant performer — delivering reception and audio quality about as good as it was possible to get from a traditional open-backed console cabinet.

Whilst the four-valve-plus-rectifier set was the predominant receiver for 1937, some manufacturers ventured into the exotic designs using up to the minute techniques. Such was Fisk Radiola's model 257. Thumbing through the *Australian Official Radio Service Manual* for 1937 shows that only four manufacturers were game enough to try the new metallic valves. Only Healing used them for all of their electric models. The other manufacturers used them sparingly, but AWA Radiola did incorporated them into the model 257.

Although the advertising brochures claimed the model 257 contained 10 valves, when pared down to basics it was a three-band superhet with a tuned RF stage. That is where the similarity to any other receiver ends!

Of all the 1937 models that were available, only a couple had push-pull 2A3's in the output. Healing marketed a very powerful set, their model 777E (seven valves plus rectifier), using push-pull 6L6's in what must have been a powerful audio stage indeed. The AWA model 262, the larger brother of the 257, also had push-pull 6L6's in the output, but the front end and other features remained the same.

Fig.1: The AWA Radiola model 257 of 1937 looked most imposing in its handsome cabinet, and had 'big' performance to match.

Stylish cabinet

For a start, the 257 was housed in a very stylish cabinet. As one leaflet says, 'The magnificent console cabinet embodies the latest tendencies in modern furniture design and features rich walnut and zebrano veneers with full polished hand rubbed finish'. True enough. As the photo in Fig.1 shows, it has a concave speaker baffle decorated with curtained grille cloth to give the appearance of a proscenium of a theatre. The well-proportioned cabinet features black pinstripe piping and black knobs and escutcheon, to highlight the beautifully grained timber.

There is a magic-eye tuning indicator, which together with the dial scale is positioned for ease of viewing whether sitting or standing. The shape of the tuning gang plates are such that the dial markings are as linearly spaced as it is possible to get, and the dial contains more than 100 station call signs.

Mechanical features

The dial is an interesting affair. Above the broadcast band station markings, which are on a flat dial, is a rotating cylinder calibrated in frequency and corresponding to the station markings below. The axis of the cylinder is parallel to the length of the dial beneath. When either of the shortwave bands are selected, the cylinder rotates, and shows the shortwave calibrations in wavelength, together with the mandatory legends 'Rome', 'Paris', 'London', 'Moscow' and so on. Why they bothered with his Lord only knows, for those markings are quite irrelevant to tuning those particular stations.

As the shortwave bands are selected, the main dial lamps are extinguished and the cylinder dial is separately illuminated. Nothing, it seems, was left to chance.

The mechanics of providing for this visual extravaganza are quite complex and would have required a considerable amount of tooling and engineering during the manufacturing process.

Another feature common to the better class of Radiolas was, for want of a better description, the 'sec-

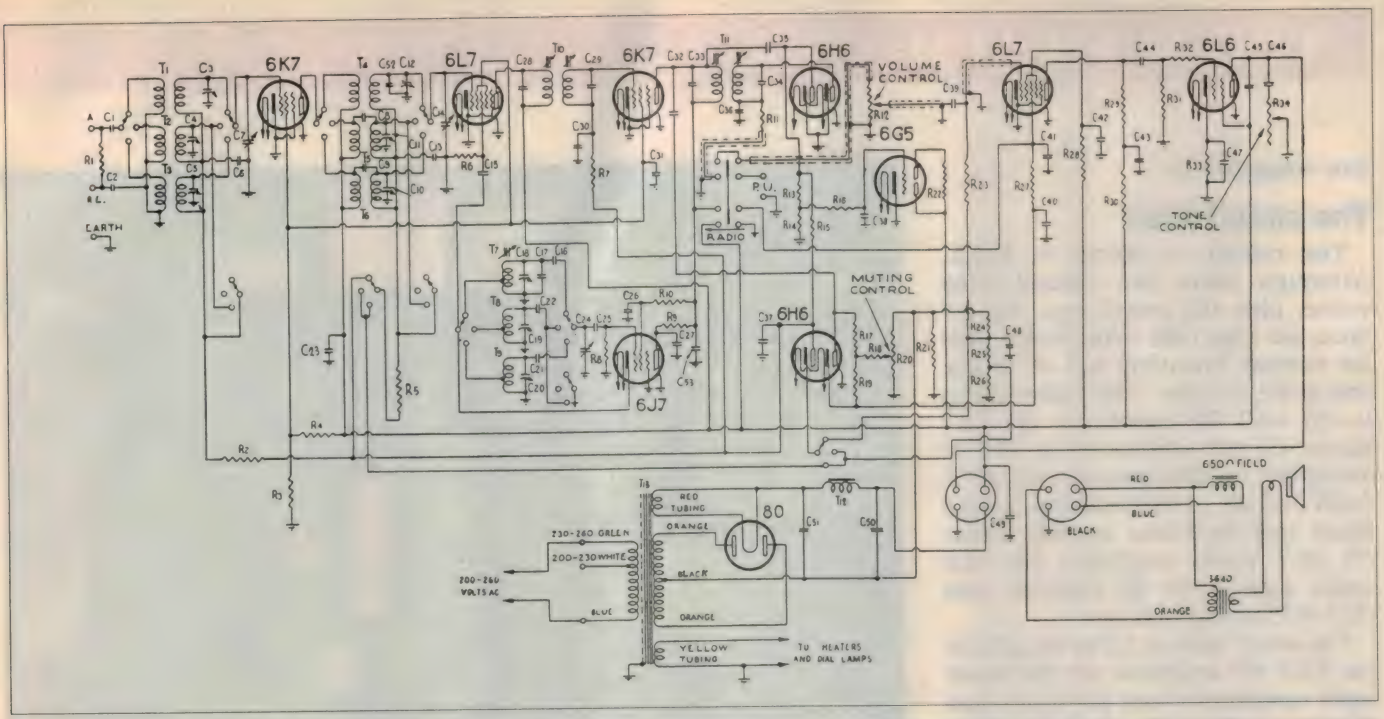


Fig.2: The circuit of the 257. With an RF stage, separate local oscillator, magic-eye indicator and audio muting system in addition to AGC, it delivered a high level of performance.

tional' vernier tuning. Normally, the tuning shaft is friction coupled to the tuning capacitor to achieve a suitable dial rotation reduction ratio. However, on this and other Radiolas, the 'outer' or main tuning shaft is in turn planetary driven by an inner or 'knob' shaft by means of ball bearings, which together with a mechanical stopper, allows only one rotation of the knob shaft that can be planetary coupled to the main shaft. After the knob shaft has reached the stopper, it then becomes directly coupled to the main shaft. Of course, the knob can be rotated in the other direction, whereupon the planetary drive will come into effect, until the stopper then directly couples it to the main shaft again.

The beauty of this system is that the slow motion effect is there right where it is needed; for searching a station — and without the need to separately engage another form of reduction gearing. The tuning knob can be gently rocked back and forth for very accurate fine tuning, particularly on the shortwave bands.

Electrical features

This is one of the few sets with a 'muting' control, which accounts for the fifth control knob in the set. The muting control is device for eliminating all signals which fall below a certain strength, as predetermined by the setting of the control. It is much like a 'squelch'.

Other features are the magic eye tuning indicator, a treble cut tone control (what else?) and a single ended 6L6 output stage driving a very high quality 'Amplion' electrodynamic speaker. The sound reproduction is about as good as is possible from this type of speaker in an open-backed console cabinet, without the recourse to full range

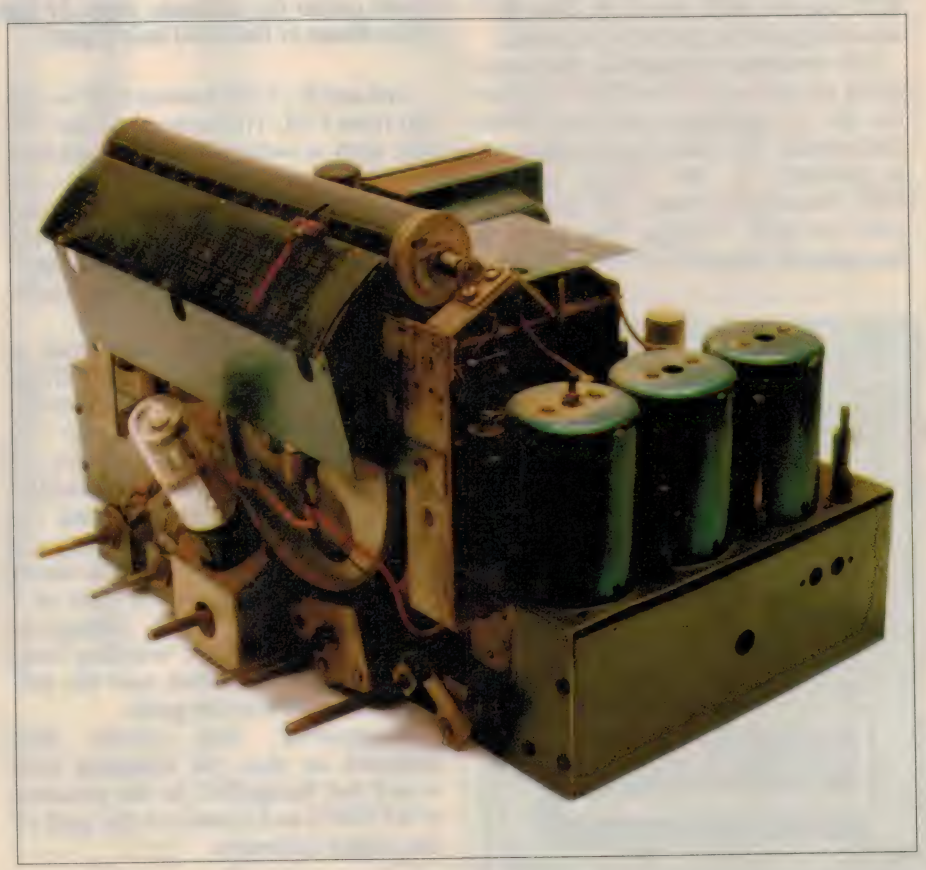


Fig.3: The chassis is quite tightly packed, explaining why metal valves must be used. Note the metalwork surrounding the dial.

tone compensation.

The circuit itself

The circuit is shown in Fig.2. Although there are indeed nine valves plus the magic eye, two of these are type 6H6 twin diodes used for various functions and of course one is the rectifier. The valve lineup is (1) 6K7 RF amplifier; (2) 6L7 mixer; (3) 6J7 oscillator; (4) 6K7 IF amplifier; (5) 6H6 detector and AVC (AGC) diode; (6) 6H6 muting control diode and back-bias control diode; (7) 6L7 audio amplifier; (8) 6L6 audio output; (9) 80 rectifier; and (10) 6G5 tuning indicator.

The aerial input is fed to the grid of the 6K7 RF amplifier via the usual input transformer (one per band), and thence transformer coupled to the super-control grid of the 6L7 mixer. The 6J7 local oscillator is an electron-coupled type, which is described as 'resistance stabilised in frequency'; the output is derived from the cathode and injected directly into the 6L7 injector gird via C15. The 6L7 was designed for just this purpose.

The resultant intermediate frequency is fed via the two IFT's (T10, T11) and the 6K7 IF amplifier to the first of the 6H6 diodes. The diode load in this case is provided by the volume control, R12. The second diode unit is to provide the AGC voltage. This diode is fed from the primary of T11 via C35.

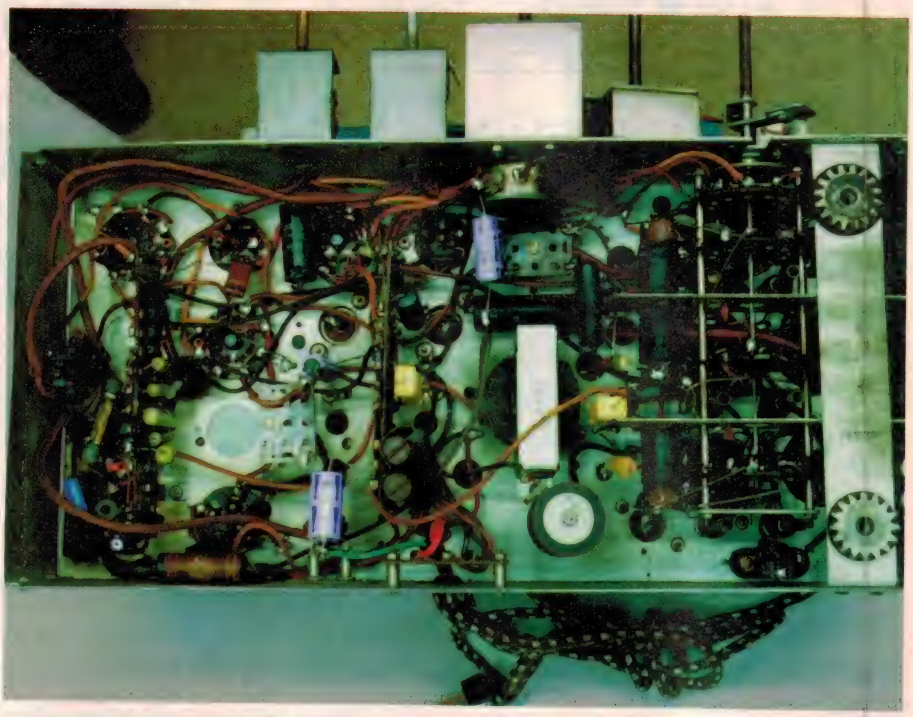


Fig.4: Although the circuit is fairly complicated, there's generally plenty of room under the chassis. Most of the components are quite accessible, apart from those in the front end (right).

The anode of the bottom 6H6 is also fed from C35. The cathode of the bottom 6H6 is switched to the back-bias network and provides about -5V (R24/R25) on the broadcast band and about -2.5V (R25/R26) on each of the shortwave bands. As can be seen, AGC is not applied to the 6L7 on the shortwave bands.

The action of the left-hand diode in the bottom 6H6 is interesting. When the carrier signal, after rectification via the left-hand diode of the *top* 6H6, becomes less negative than the standing bias, the anode is positive with respect to the cathode and the valve conducts, thereby applying the standing bias upon the grids to which it is switched. When in the case of a stronger signal the AGC voltage is more negative than the standing bias, the valve has no effect and the full AGC is applied to the grids.

Presumably, this circuit was included so that the standing bias would not be applied to the junction of R13/R14 and thence to the grid of the tuning indicator.

The muting diode

R20 is the muting control, and ultimately controls the voltage applied to the injector grid of the 6L7 audio amplifier stage. The voltage of this injector grid has a marked bearing on the gain of that particular valve. It gives it a variable-mu effect without the need to involve the control grid, such as in the case of an ordinary variable-mu RF pentode.

When R20, which is only a 3000Ω pot, is at the earth end, R18/R19 form a cathode load for the right-hand diode of the bottom 6H6. Depending upon the signal strength, a slightly positive voltage will appear at the cathode, and once filtered via C40/R27/C41, appears at the injector grid of the 6L7 — allowing maximum gain. In this position, the injector grid measures up to +1.0V on a strong signal, and about -0.3V on a weak signal.

When R20 is rotated fully in the other direction, the full back bias (as derived across R21) is applied to the cathode and more importantly to the injector grid of the 6L7, thereby reducing considerably the gain of that stage. The incoming rectified signal must exceed this bias before the diode can conduct and apply the positive

voltage to the 6L7. R17 functions to provide the diode load, together with R18, and together with R19 provides a 2MΩ bleed across the diode.

The voltages I measured at the injector grid of the 6L7 when the full muting was applied were -0.25V with a full signal and -10.6V with no or weak signal. This amount of bias (injector grid voltage) is sufficient to almost turn the stage off!

The muting control is very effective on short waves — so effective that nothing gets through! On the broadcast band it does ensure that only the stronger signals are passed. Just why it was incorporated is open to debate; it is quite an enigma. The scheme was dropped the following year.

In all probability it was seldom, if ever, used by the listener — but it made a great sales pitch. In an era when the ability to 'pull in' weak stations from hither and yon was a major attribute of any receiver, and such abilities were energetically extolled by salesmen, why did AWA put in a control that cuts them out?

Performance

The performance of this set is nothing short of outstanding in every respect. This model marked the introduction of the new slug-tuned intermediate frequency transformers, the high impedance Litz-wound primary winding on the broadcast band aerial and RF coils, rigid 'air trimmers' for all stages on all bands, and quite solid mechanical assembly of the whole chassis. AWA in particular made exceedingly good coils, and RF and IF transformers which were sealed against moisture.

AWA's are arguably the best Australian made receivers, in fact.

Selectivity is very sharp, and although I had no access to a laboratory standard signal generator in order to undertake definitive testing, seasoned and experienced ears will realise that this set is about as good as it is possible to get. The next step up from this design would be a communications receiver.

Repairs & restoration

Access to factory literature is a definite advantage if you want to repair and/or restore this type of set, but is possible to work from just the circuit diagram. Short of trying to repair a simple fault, a circuit diagram is a must. It is published in the *AORSM* for 1937.

Whilst AWA made very good coils, unfortunately the same cannot be said for their black paper capacitors! (They earned a reputation for leakage and capacitance loss early in their working life).

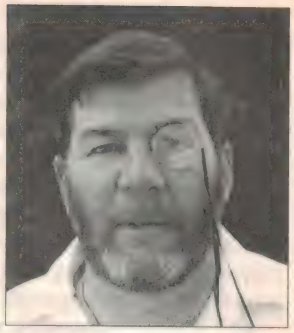
Providing no one has 'mucked around' with the coils or the switches, or attempted to doctor the muting control, most components on the mounting panels can be located even though it might take a little time. In this regard, the factory literature is a definite bonus.

Unfortunately, although some may disagree, the metal valves as specified are a must. As well as there being insufficient space for the glass counterparts, the socket assembly is such that the larger bases of the glass equivalents will not seat properly in the sockets designed for the metal types. Also, glass 6H6-GT's provide no shielding against stray pick-up and the result is a burst of audio instability.

If, after repairs, the voltages match up to those stated and a standard alignment procedure is followed, this receiver can take pride of place in both appearance and performance and enhance the best of collections. ❖

Moffat's Madhouse...

by TOM MOFFAT



Virtual Tom whoops it up!

Ah, how did we ever live without e-mail? It might sound like I'm getting obsessed with it. I've already devoted a couple of these columns to e-mail in the past few months; the romantic side as e-mail love letters, and the dangerous side of e-mail privacy issues. Now comes something new and completely different: how to transport yourself to a party half a world away, as Virtual You.

Those of you who use e-mail a lot may have discovered one of its most addictive features: tracking down old and almost forgotten friends. In my case, most of these are people I used to work with in television in Hobart. It started with one person, who then handed my e-mail address to others, who then wrote a note to me and then handed my address along to yet someone else. Great fun! And very nostalgic.

One message casually mentioned an upcoming event:

The other reason for this greeting is to inform you of the next great TVT6 reunion.

IT'S REUNION TIME AGAIN FOR PRE-1994 EMPLOYEES OF TVT6, OR TASTV.

WHEN: SATURDAY 1st MARCH 1997

WHERE: POLISH CLUB (of course)

Numbers are limited, so we need to know ASAP if you would like to come.

Would I like to come? Oh, yes. I went to their last reunion and it was a party to remember (or forget, depending on your point of view). But there was just one little problem: the matter of 15,000 kilometres between me in the USA and the Polish Club in Hobart, the traditional watering hole for all my TV workmates. But, once again, e-mail came to the rescue:

Thank you very much for the invitation. I have thought about it all day and I have decided I shall attend, in effigy. I have enclosed a kit of materials for constructing a Virtual Tom.

Attached to this message is a photo, TOM.JPG. I suggest you print it out, nice and big, glue it to a piece of cardboard, and prop it up in a spare place at a table among my friends. It might be nice to include a name tag to introduce me to friends I haven't met.

As my attempt at conversation as Virtual Tom, I have included some suggested questions and answers, attached as TOMSFAQ.TXT. Perhaps you can print these out and set them on the table in front of me.

All that's left to do now is scatter a few beer cans around me and the effect will be complete. If the night is really successful it might even end up as the subject of a Moffat's Madhouse column in Electronics Australia. Please let me know how it goes, and if I behaved myself.

I'm looking forward to being with all of you at the Polish Club. Perhaps if I am only a cardboard cutout I can stay out of trouble.

It was with some trepidation that I launched this e-mail message toward Hobart. What a screwball idea! These people would surely think I had lost my marbles once and for all...

Everything then went very quiet, and I decided the TV people had judged my silly idea as being not even worth responding to. But then, a few weeks later, came another message from Hobart:

Hi Tom. Got your reply to the reunion invite. I believe Bruce Woods is in the process of screening the 'Virtual Tom'. (The rest of us are hard at work on the empty bottles, tinnies etc...)

Oh, Wow! They did take it seriously! This was really going to happen. I started to get nervous about it, a bit like a kid looking forward to his first date. This crazy idea was going to become public knowledge very soon now, and I might be facing embarrassment as a total crackpot.

I worked out the time differences. Assuming the party started at 8:00, that would be 1:00 on Saturday morning here. On the night before I had to work on a gig for the Port Townsend Symphony Orchestra, doing sound and lighting for their concert. I got home about one hour, in real time, before the party in Hobart started. So I sat up and waited. Should I perhaps phone the

Two views of the reunion bash, sent to Tom (and us) via e-mail.

How the 'Virtual Tom' doll looked.

Polish Club at the moment the party starts? Maybe they would phone me. As it turned out, nothing at all happened, and I gave up and went to bed.

The following night the Orchestra had another gig, so I was out until after midnight again. When I got home I checked my e-mail, and lo and behold there was a long letter about the party — along with 15 pictures taken with a little Kodak DC20 digital camera.

I cracked a stubby or two, and then went over and over those photos, again and again. There were people sitting with this little doll of ME, and others were holding up signs that said 'HELLO TOM' and 'MOFFAT'S MOB'. And — most of those people had GRAY HAIR! They didn't when I used to work with them. It's been a long time. What a blast!

In fact it had been so long that I couldn't recognize many of them, so I had to impose on Bill Lee, former Commercial Production manager at Channel Six and long-time friend. He was the one who constructed the 'Hello' signs, using his computer of course, as well as organizing the digital pictures. So I e-mailed Bill once again, swallowed my pride, and asked him to send me a list of names of the people in the photos. And then I went over the photos yet again — "surely that couldn't be so-and-so". But it was, so many years on. It was, really, just like being at the reunion in person.

Virtual Tom turned out to be more than just a mounted photo. One of the technicians at Channel Six television, Bruce Woods, is one of those people who can make anything out of anything (he even makes his own clothes). So the job of making Virtual Tom fell upon him.

The original photo was a self-portrait made with an Epson PhotoPC 500 digital camera. I just held the camera out at arm's length, turned it back toward my face, and pressed the shutter a few times. Nothing wasted; with a digital camera, film and processing costs are zero.

The chosen photo was in 640x480 pixel, 16-million colour format, ready to e-mail to Hobart as a .JPG file. From the looks of the photos from the party, they must have digitally enlarged it somewhat before printing it out onto paper. Bruce Woods made cardboard cutout of an oversized head (obviously a legacy of my days as a television star) and then a body with arms and legs, and even a necktie. Following a cut-and-paste job on the photo, Virtual Tom came to Virtual Life.

Virtual Tom wasn't alone. The idea spread, and by the time the party began there was also Virtual Phil, an outside-broadcast technician who missed the reunion because he was otherwise engaged on an OB job in Melbourne. Virtual Phil and Virtual Tom then made the rounds of the Polish Club, first the bar and then the function room, chit-chatting with the other guests. Virtual Tom's list of Frequently Asked Questions came in handy for those who wanted to know "what ever happened to...". As for Virtual Phil, his wife was there to answer questions live.

When the party was over, and I was viewing the pictures, I started wondering — what happened to Virtual Tom after the bash? I thought he might make an interesting souvenir if I could figure out a way to get him to Port Townsend. But further e-mail inquiries revealed

My old colleague Tom Payne, with sign.

that Virtual Tom had gone home with one of the lovely young ladies from the party. Kidnapped, in fact. That's OK then. All's well that ends well.

So there's a crazy idea that worked. A virtual party spread out over 15,000km of ocean. It reached over most of Australia as well, but with real live people who flew into Hobart for the occasion. More of my far-flung friends. And one major spinoff of the whole business has been a flurry of even more e-mail from people I'd totally forgotten about. Now correspondence, and digital pictures, are flying fast and furious.

Were we first, and did we start a new fad? Maybe so, and maybe not. This morning's *Peninsula Daily News* carries a story headed 'Online Partying Off the Mark?'. According to this story from Associated Press, companies like the makers of Captain Morgan's Rum are running World Wide Web sites which encourage people to log on and then join in on things like games and chat, while consuming the company's product.

'Steel yourself for the hilarity of today's most outrageous young comedians', beckons Captain Morgan's web site. The problem, of course, is the alleged encouragement of under-age drinking amongst the target audience: teenagers and university students. Captain Morgan's site has a warning posted, 'Avast, you must be 21 years old to enter this site', but of course there's no real way of checking.

What is worrying to me is that on-line parties with virtual guests may tend to replace the real thing, even when there is no distance problem involved. Shy people can get their giggles without needing to front up in person.

It's a bit like ATM machines; do we ever face a bank teller any more? I've resisted the ATMs as much as possible. One of my weekly pleasures is my Friday afternoon trip to the bank, inside to the counter, where I'm treated to a few pleasant moments with the bank's 100% female staff. They are definitely NOT machines, and I'm most grateful! ❖

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Here we feature some items from past issues.

July 1947

Single Frequency for Sound & Vision: A new television system in which only one wavelength is used, in place of the two separate transmissions, was shown in the Radio group at the British Industries Fair, in May. Known as 'Videosonic' television, the recurrent 'flyback' period (equivalent to the dark interval between successive cinematograph images) is used to accommodate the sound signal.

The exhibit featured a full-scale working Outside Broadcast television van. The output of a television camera of the firm's own manufacture, trained on an enlarged photograph, was passed through the OB van which this exhibitor also makes.

In England, television services are continuing on much the same lines as before the war. Technically the results are quite good, the main problems being those of programmes and the high cost of equipment and service.

July 1972

Largest Superconducting Motor: The world's largest superconducting motor — a 3250 horsepower DC machine — has just completed its test program driving a water pump at Fawley power station. The lessons learned are helping to provide new propulsion systems for the navy and AC generating sets in the 2000 megawatt class.

The motor is a homopolar machine with a superconducting field winding which provides nearly three million ampere-turns, to give a maximum flux density of 3.7 tesla. The winding is maintained at the very low temperature of 4.4K by means of liquid helium supplied by a closed-cycle refrigerator. The armature of the machine is at ambient temperature and is a segmented Faraday disc.

Highest Frequency Ever Measured: Measurement scientists have made the highest frequency measurement ever made — and they did it with a catswhisker diode. By measuring the frequency of an infra-red laser whose wavelength was already known, a team of scientists at the US National Bureau of Standards laid the groundwork for linking the international standards of length and time.

The experiment, conducted by a team of four scientists at the NBS laboratories in Boulder, Colorado, found the absolute frequency of the helium-neon laser to be 88,376,245,000,000Hz, only a factor of five lower in frequency than visible light.

This highest frequency measurement yet made by man represents a 100-fold increase in the span of frequency measurements over the last four years, and surpasses the recent record achievement of a team of MIT scientists. ❖

EA CROSSWORD

ACROSS

1 Unit used in assembly. (6)
4 Major electronics brand. (7)
10 Name of effect that makes the sky blue. (7)
11 Recording data. (7)
12 Corrosion. (4)
13 Name given to constant impedance network. (5)
14 Points where radiation is concentrated. (4)
17 Type of lamp fitting. (7)
19 Multi-electrode valve. (6)
22 Gaseous element. (6)
23 Study that determines size of large areas. (7)
26 Specification of a computer monitor. (1,1,1,1)
27 Phonetic alphabet term for fourth letter. (5)
28 Information. (4)
32 Metal used in certain batteries. (7)
33 Small paper-based recording device. (7)
34 Diffracting construction. (7)
35 Brand of recording tape. (6)

SOLUTION TO JUNE 1997:

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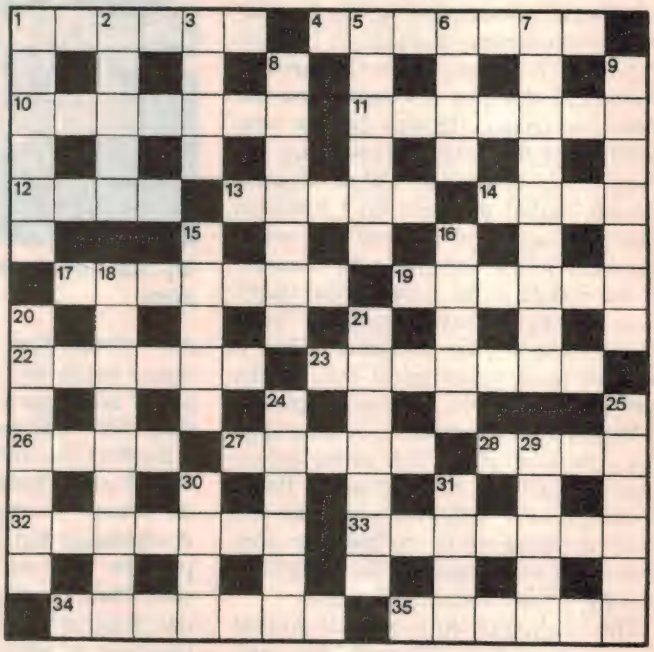


DOWN

1 Electrical drive devices. (6)
2 Outdated units of force. (5)
3 Phase-angle difference. (4)
5 British astronomer with name linked to a comet. (6)
6 Joining points. (4)
7 Having the property of neutron absorption in reactors. (9)
8 Mixed metals by fusion. (7)
9 Device initiating a reaction. (7)
15 Regular department of EA magazine. (5)
16 Computer term contrasting 'writes'. (5)
18 Type of clip. (9)
20 Sound of train signal. (7)
21 Distant planet. (7)
24 Nationality of Hertz. (6)
25 Composer of oratorios (1685-1759). (6)
29 Computer brand logo. (5)
30 A suggestion of a solution. (4)
31 Electronic data conversion. (1-2-1) ❖

Electronics Australia's

Professional Electronics

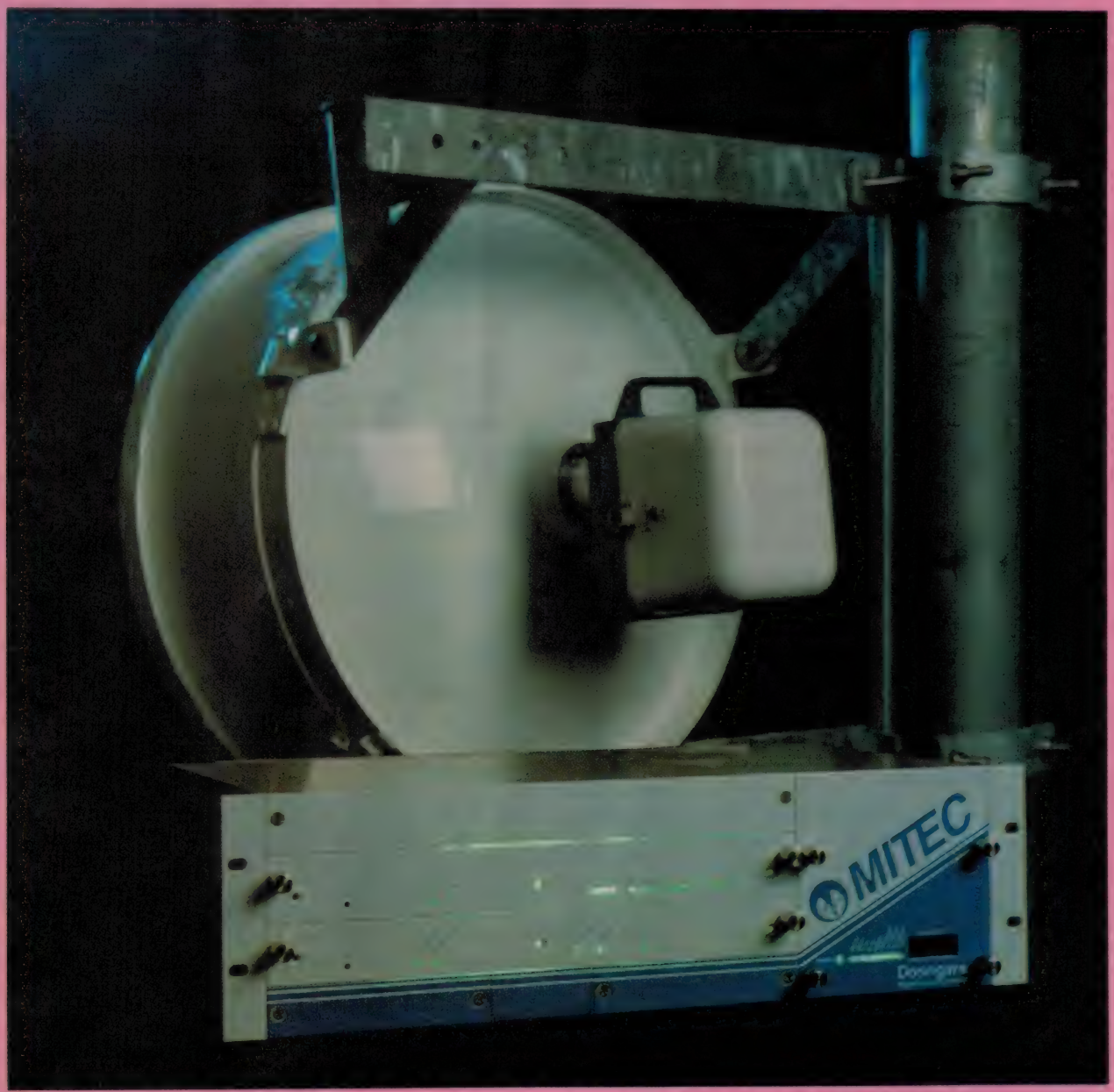
S ◆ U ◆ P ◆ P ◆ L ◆ E ◆ M ◆ E ◆ N ◆ T

JAPANESE FIRM BUYS RIGHTS TO 'QUIET LIGHT' DEVICES DEVELOPED BY RESEARCHERS AT UNIVERSITY OF CANBERRA

FIRST FIVE IRIDIUM COMMS SATELLITES NOW IN ORBIT

REVIEW OF NEW US ROBOTICS SPORTSTER 33.6 VOICE MODEM

TELEDESIC SIGNS US$9 BILLION CONTRACT WITH BOEING



MITEC'S NEW D-SERIES DIGITAL MICROWAVE RECEIVER: OPERATION FROM 2 - 22GHZ, AT G.703 DATA RATES OF 2M, 8.44M OR 34.36M BITS/SECOND

NEWS HIGHLIGHTS

HAMAMATSU BUYS OZ 'QUIET LIGHT' TECHNOLOGY

Two researchers in quantum electronics from the University of Canberra (UC) have sold the rights to a Japanese company for their 'quiet light' invention, which is claimed to foreshadow a new generation of optoelectronic devices.

Well known Japanese company Hamamatsu Photonics KK has acquired the sole rights to develop a class of novel photon-coupled 'quiet light' optoelectronic devices patented by Professor Paul Edwards and Dr William Cheung of the School of Electronic Engineering and Applied Physics in the Faculty of Information Sciences and Engineering at UC.

"The patent is generic and we believe it will cover a range of new 'quiet light' optoelectronic devices with potential applications in computing, communications and instrumentation systems", said Professor Edwards.

"We are delighted that the commercial value has been realised by one of the international leaders in the field of photonics", said Dr Cheung.

According to Professor Edwards, natural light is noisy and therefore is limited in information capacity. The invention employs amplitude-squeezed light in which the photon number fluctuations are suppressed below normal shot noise levels. It has applications in the many circuits and systems for which performance is shot-noise limited.

The University of Canberra quantum electronics group has been working for the past five years with Dr Peter Lynam in the School of Physics at the Australian Defence Force Academy, and colleagues in the Solid State Division of Hamamatsu Photonics.

The group was the first in Australia to demonstrate the generation of photon-number squeezed light and also the first to generate quantum-correlated multiple light beams using high quantum efficiency light-emitting diodes and laser diodes.

The sub-shot noise amplifier concept arose out of fundamental studies of quantum-correlated light at the University of Canberra The precursor to the device was recognised as one of the major advances in the field of quantum optics by the Optical Society of America in 1993.

International patents have been filed under the agreement with Hamamatsu Photonics, which includes royalty payments to the co-inventors. The company has undertaken to support further research by the Australian group.

According to Professor Edwards, there has been a reluctance in Australia to accept the relevance of quantum noise suppression techniques to new technologies.

"Even our own University was advised that the invention was of no commercial significance", he said. "The problem with applied research in Australia is that we usually have to go off-shore for recognition and commercial development", he added.

DSE SELLING CABLE MODEMS

Dick Smith Electronics has been appointed a key retailer for Telstra's new Big Pond Cable Internet Service, which provides Internet access at speeds up to 100 times faster than conventional services. Cable Internet's high speed potential comes via the Motorola CyberSURFR cable modem, which can transfer data downstream (i.e., towards the user) at up to 30Mb/s, and upstream at 768kb/s.

Almost one million households in Sydney and Melbourne have access to Cable Internet through Foxtel's cable network and Telstra Big Pond. It is not necessary to be a paying Foxtel subscriber.

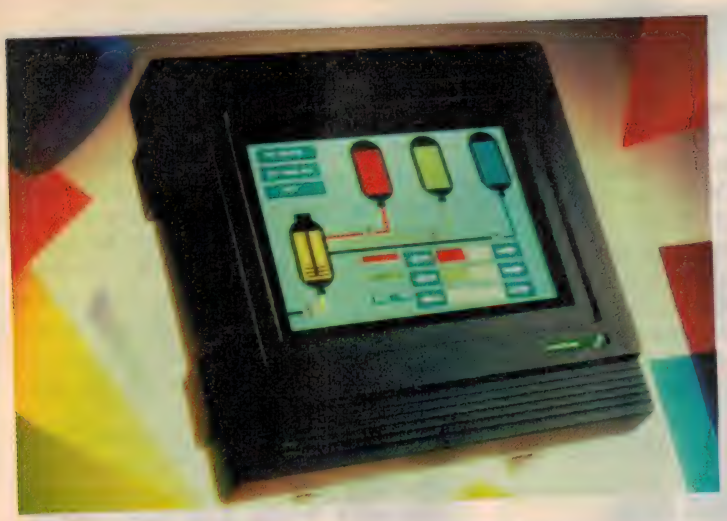
As Telstra's key retailer, Dick Smith Electronics can assist consumers by confirming if cable is available at their address, supplying the cable modem (RRP $595), offering discounts on associated hardware and arranging connection through Telstra Big Pond. Purchase of the cable modem is conditional upon the customer signing a 12-month contract with Telstra Big Pond.

Cable modems are available through selected Dick Smith Electronics stores in Sydney and Melbourne, with demonstration sites at the York Street and Parramatta stores in NSW and Springvale and Brighton in Victoria.

FIRST 5 IRIDIUM SATELLITES LAUNCHED

The first five of 66 Iridium satellites were successfully launched on May 5 abourd a McDonnell Douglas Delta II rocket, from Vandenberg Air Force Base in California, USA. The launch marks an important step toward Iridium LLC's goal of providing global wireless voice, paging, facsimile and data services worldwide by late 1998.

All five satellites were deployed, beginning 63 minutes after lift-off. They were to undergo in-orbit bus testing on the way to their final target orbit (421.5nm), where the communications payloads were



Lucas Control Systems has released this Pentium based Deeco workstation for clean-room environments. It's completely sealed and uses an IR touch screen system instead of a keyboard.

to be tested. The five satellites will be located in a slightly inclined (86.4°) orbital plane and will form part of the first orbital plane of the Iridium constellation. Subsequent satellites will be deployed in six circular polar orbits, with 11 operational satellites per plane.

This first launch represents the first step in building the Iridium constellation. The initial satellites will be used to test satellite command and control capabilities and basic hardware and software functionality.

Iridium LLC is an international consortium of leading telecommunications and industrial companies financing the development of the Iridium system. Owner organizations include Iridium Africa Corporation, Iridium Canada, Inc., Iridium China (Hong Kong) Ltd., Iridium India Telecom Limited, Iridium Middle East Corporation, Iridium SudAmerica Corporation, Khrunichev State Research and Production Space Center of the Russian Federation, Korea Mobile Telecommunications of Korea, Lockheed Martin Corporation and Motorola, Inc. of the USA, Nippon Iridium Corporation of Japan, o.tel.o communications GmbH of Germany, Pacific Electric Wire & Cable Co. Ltd. of Taiwan, Raytheon Company of the USA, Sprint Corporation of the USA, STET Group (Societa Finanziara Telefonica per Azioni) of Italy, and Thai Satellite Telecommunications Co. Ltd. of Thailand.

YOUR COMPUTER/GOLDSTAR SUBS COMPETITION

First and second prizes in the Your Computer/Goldstar Multimedia Subscription Competition were a Goldstar 17" High Resolution Colour Monitor plus 6X speed internal CD-ROM drive, with each prize valued at $1670. The winners were B. Ellis of Mooroolbark in Victoria and T. Myers of Bundoora in Victoria.

Third and fourth prizes were a Goldstar Studioworks 15" Multimedia Colour Monitor plus 6X speed internal CD-ROM drive, with each prize valued at $1130. The winners were D. Thiele of Lobethal in SA and D.C. Waugh of Sunnybank, Qld.

The eight runners-up each won a Goldstar 6X speed internal CD-ROM drive valued at $375. The winners were: A. Bishop, Wellington NSW; Marcellin College, Randwick NSW; A. Pearsall, Laverton Vic; D. King, Toowoomba Qld; D.R. Chase, Walla Walla NSW; N. Gilford, Port Broughton SA; K.W. James, Scottsdale Tas; and J. Richards, of West Ryde NSW.

LONGEST NO-REPEATER FIBRE-OPTIC LINK

Pirelli Cables has announced that Powerlink Queensland will install its optical amplifier system to carry live telecommunications traffic in their SDH network in Queensland. The new 150km SDH link will be the longest known unrepeatered terrestrial span for a power utility in Australia, to carry live traffic.

Pirelli's booster amplifiers are the key components used by Nokia — a Powerlink SDH supplier, to double the distance over which traffic can be transmitted. In this case, Pirelli's optical system allowed Powerlink to avoid one mid-span regenerator hut.

"Pirelli is proud to offer the strongest

NEC AUSTRALIA ROLLS OUT TINY PHS SETS

NEC Australia has released Personal Handyphone System (PHS) technology for the Australian market as a feature of its popular NEAX PABX systems.

According to NEC the NEAX is already installed in 50% of Australia's medium and large-sized businesses, and the PHS feature should therefore significantly enhance existing capabilities.

NEC's PHS phone unit, called the DTERM Cruiser, is so tiny it can fit comfortably into a shirt pocket, and is claimed as the smallest (123 x 38 x 28mm) and lightest (95g) phone so far available in Australia. They also have a battery life of 500 hours on standby and eight hours of continuous talk before recharging.

With NEC's PHS wireless PABX system, employees receive a handset and an extension number. They can be reached by PHS wherever they are within 500 metres of the PABX area. Cell stations are installed throughout the building to enable PHS handsets to act as mobile cordless phones.

BHP Minerals' Cannington Mine in Queensland was the first company in Australia to purchase PHS technology, and Melbourne University has also been trialling PHS since August 1996.

According to NEC the introduction its PHS wireless PABX feature is the first major step since Austel and the Spectrum Management Agency announced PHS as an approved standard in December 1996.

PHS handsets operate in the 1.895 - 1.918GHz band, with an output of 10mW. They use ADPCM digital voice coding/decoding, at a rate of 32kb/s.

and most efficient multivendor optical amplifier systems in Australia", said Massimo Mariani, General Manager of Communication Systems in Australia. "Transmitting voice, data, image and video across long distances is important to many telephone companies as well as power companies, which could benefit from the forthcoming deregulation in July 1997."

Many carriers like New Zealand's Clear Communications have been using Pirelli amplifiers since 1995, to replace traditional electrical-to-optical regenerator equipment, thus achieving longer links without intermediate amplification while lowering costs and reducing maintenance requirements. In addition, by installing amplifier systems in central offices with central office switches rather than in mid-span equipment huts, these companies are able to reduce the potential of network failure due to acts of vandalism of equipment in outlying areas.

In Australia and New Zealand Pirelli Cables recently announced the commercial availability of Pirelli's new generation of Wave Division Multiplexing and Hybrid Fibre Coax systems, based on the use of the state of the art technologies, such as optical amplifiers with output power of 23dBm.

This new product generation will achieve unrepeatered distances in excess of 300km, for systems operating at 2.5Gb/s, over standard single-mode fibres.

ELECTRO EXPO 97 COMES TO BRISBANE

The Electrical Contractors Association of Queensland will hold ELECTRO EXPO 97 at the Brisbane Convention Centre in Southbank from 5 - 7th August 1997. The ELECTRO EXPO series of trade exhibitions and seminars have been held bi-annually since 1985 and have become one of Australia's leading trade shows for the electrical industry. They provide Australian and international manufacturers with the opportunity to display the latest technology for electrical installations in mines, factories, offices and homes. Visitors have the opportunity to view, assess and have personal demonstrations of the equipment and components on display, by the experts manning the exhibits.

Previous ELECTRO EXPOs held at the Brisbane Entertainment Centre and the Brisbane Exhibition Centre have attracted over 200 displays and more than 6000 visitors. ELECTRO EXPO 97 will expand to take up two halls of the Convention Centre, creating a massive floor space of 7500m^2.

In addition to the displays, there will be free daily seminar programmes covering selected business and technology topics, presented by specialists. For further information contact the Electrical Contractors Association at 51 Berwick Street, Fortitude Valley, 4006; phone (07) 3252 7488 or fax (07) 3252 4320.

INTEL CONFIRMS BUG IN PENTIUM II/PRO

Intel Corporation has formally confirmed an erratum, or what is commonly known as a bug in the Pentium Pro and Pentium II processors, called 'flag'. Intel says the flag erratum can be handled immediately with a software 'workaround', and future designs will eliminate the problem.

Intel also confirmed other reports which said the flag erratum does not affect standard Pentiums and Pentiums with MMX technology.

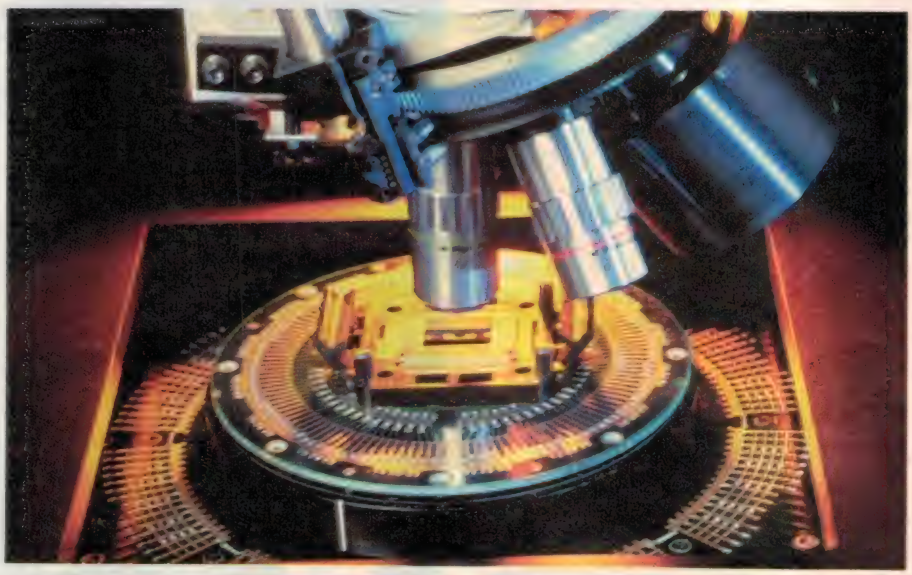
Id Software's technical director, John Carmack, stated the bug more simply, saying, "As I understand it, the Pentium Pro processor and Pentium II processor erratum manifests when storing 80-bit values, which almost nobody ever uses."

Baan Americas, Microsoft, Computer Associates, Corel, SCO, Oracle and other major software companies came to Intel's support, according to a message posted at Intel's Web site. They all confirmed the flag erratum does not affect their product and promised continued investigations. Paul Maritz, a Microsoft VP, said "After initial investigation we believe our core operating systems and applications are unaffected by this processor erratum."

As part of a 'go public with bugs' program developed after a 1994 bug revelation, Intel published a response on the company's World Wide Web site (at **http://www.intel.com/design/news/flag**). The flag erratum is number 62 on the Pentium Pro list and number 25 on the Pentium II errata list. (Newsbytes News Network)

WESTEK INDUSTRIAL PRODUCTS SETS UP

The people behind the original Industrial Products Department of Westinghouse Brake & Signal Co (Aust) have formed a new and independent organisation, to continue the business relationships established over many years. The new company is Westek Industrial Products Pty Ltd, headed by Marketing Manager John Thompson, and has established its headquarters in the newly-built Laverton North Industrial Estate, between Melbourne and Geelong.



Fremont-based Hypervision has developed the DEMI docking emission microscope, which allows location of transient faults in complex high-speed chips by using test vectors from ATE equipment to 'light them up'. The chips can be viewed from the rear, using Hypervision's 'Chip UnZip' backside thinning system.

C&K ELECTRONICS & JESEC SWITCHES MERGE

Component suppliers C&K Electronics and Jesec Switches Plus have merged, to combine over 40 years industry experience. The new company, called C&K Components Plus, has its head office and distribution centre in Braeside, Victoria, with sales offices in Sydney and Adelaide and sales agents in Queensaand and WA.

The merged company plans to expand its present range of 15,000 stock line items including switches, connectors, enclosures, circuit protection devices, variable resistors, sound and visual components and general. An ISO9002 endorsed quality control system will ensure a fast and efficient response to customers' needs.

Merger partners Barry Davenport, Bob Tozer and Kevin Dix are extremely happy to be bringing together their years of experience. C&K Components Plus will soon be announcing its Web presence at **http://buynet.com.au**.

The Westek product lineup includes filters, chokes and instruments from Schaffner Electronik; Westcode semiconductors; power and frequency response analysers from Voltech Instruments; surge protectors from Telematic Systems; and a variety of other components.

The new company's address is Unit 2, 6-10 Maria Street, Laverton North 3026; phone (03) 9369 8802 or fax (03) 9369 8006.

MOTOROLA & LOS ALAMOS LAUNCH PARTNERSHIP

Motorola Inc. and Los Alamos National Laboratory have signed a Cooperative Research and Development Agreement that is expected to lead to technical advances in computing power and semiconductor design. Future joint projects may lead to the development of new kinds of sensors and new computer processor architectures.

Los Alamos will benefit from Motorola's expertise and stature in electronics and communications technologies, to help the Laboratory incorporate specialized software into a variety of operating systems for its national security mission. The semiconductor giant wants to tap Los Alamos' unrivaled expertise in the fields of computer simulations and modelling, for the design of future-generation semiconductor chips. Motorola and the Laboratory expect the partnership to lead to new methods of acquiring, analyzing, and interpreting large amounts of data at extremely high rates.

Los Alamos National Laboratory is operated by the University of California for the US Department of Energy.

MELBOURNE CASINO USES PACOM CCTV

Melbourne's new Crown Casino is claimed to be equipped with the largest and most advanced closed circuit television (CCTV) system in Australia. The equipment, valued at over $3 million, has been supplied by Pacific Communications (PACOM), a leading provider of advanced CCTV surveillance systems, and installed by Honeywell and PACOM.

The installation includes 1100 state-of-the-art Ikegami ICD700 digital processing colour remote control PTZ (pan/tilt/zoom) and Panasonic 614 and 414 remote control PTZ and fixed video cameras. These networked cameras will provide extensive surveillance coverage of patrons and staff. Some of the cameras will be concealed above and on the side of the gaming tables.

A key part of the installation is PACOM's 2030 Matrix Switcher, which will link the cameras to a central surveillance control room. With 1664 inputs, 104 outputs and 19 separate operator positions, it will be the largest 'networked' switcher in Australia and one of the largest in the world. The switcher enables operators to move rapidly between cameras, monitors and VCRs.

500 VCRs with infra-red controls located in the surveillance control room will record each camera 24 hours a day, seven days a week via an extensive VCR managernent system. Operators each with video monitors and using PACOM's latest 2035 Intelligent CCTV keyboard will keep watch on the proceedings. The surveillance control room will also be able access the monitors of a separate security control room.

Detective Sergeant Clive Rust, head of the Casino Crime Unit said: "We regard this surveillance system as our greatest asset. The ability to videotape offences as they are being committed will, we are confident, prove to be a major deterrent to crime in the casino."

HP & FLUKE FORM DISTRIBUTION ALLIANCE

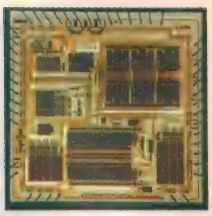
Hewlett-Packard Company and Fluke Corporation, world leaders in test and measurement, have signed a reciprocal distribution and marketing agreement that will enable customers to buy HP's Basic Instruments from selected distributors of Fluke products. According to the agreement, HP will sell and support several of Fluke's compact electronic-test tools. (Business Wire) ❖

NEWS BRIEFS

- Mr Brian Lee has been appointed by ***Amber Technology*** to the position of marketing manager — consumer products.
- ***Intelligent Systems Australia*** has announced the development of the company's 'new look' Web site, found at http://www.intelsys.com.au.
- Mr Stephen Aldridge has been appointed chief executive officer of ***Securitas Electronic Protection Services Ltd***, a new Australasian company formed by the Signature Security Group. ❖

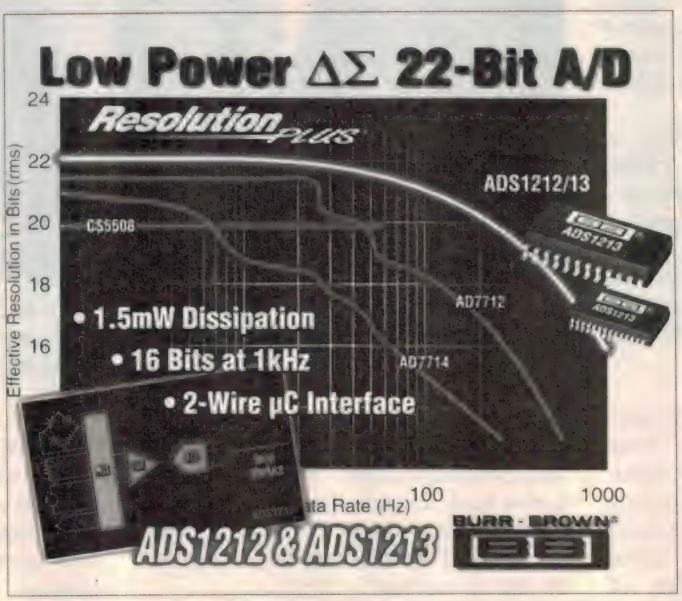
Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY...



22-bit A/D converters

The new ADS1212 and ADS1213 from Burr-Brown are low power, precision, wide dynamic range, 22-bit delta-sigma A/D converters operating from a +5V supply. The ADS1212 is a single channel converter; the ADS1213 is a four-channel multiplexed converter. Both devices have an SPI compatible synchronous serial interface and a two-wire control mode for low-cost isolation. The devices are suited for high resolution measurement applications in smart transmitters, industrial process control, chromatography and portable instrumentation.



The ICs feature an effective resolution of 16 bits at 1kHz through a 'turbo mode' operation which gives the benefit of matching the resolution and data rate to power consumption requirements. Specifications include 22 bits no missing codes, 20 bits effective resolution at 10Hz, 1.4mW power consumption, differential inputs, programmable gain amplifier, internal/external reference and on-chip self calibration.

For further information circle 272 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700.

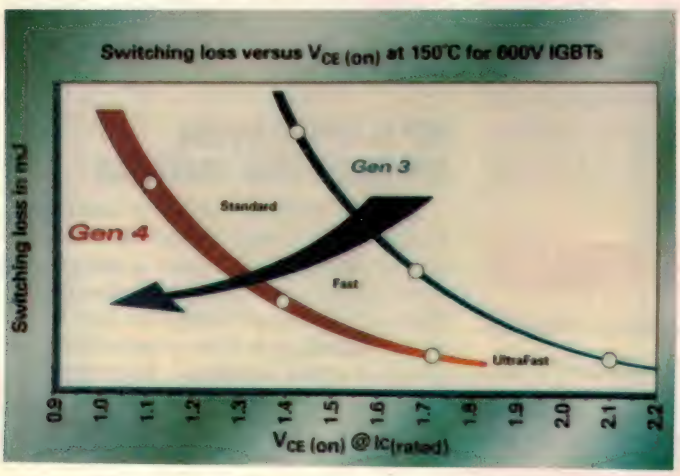
Charger IC for Li-Ion, NiCad & NiMH batteries

Analog Devices' ADP3810 and ADP3811 precision battery charger controllers feature user-programmable current limiting and precise voltage limiting to provide constant current, constant voltage battery charging for lithium ion (Li-Ion), nickel cadmium (NiCad) and nickel metal hydride (NiMH) batteries. Both ICs integrate a precision 2V reference, control input buffer, an undervoltage lockout comparator, output buffer, and over-voltage comparator into an 8-pin SOIC.

The ADP3810 features on-board precision resistors for +1% overall accuracy when charging Li-Ion batteries and is available in four voltage options: 4.2V, 8.4V, 12.6V, and 16.8V. The output voltage of the ADP3811 is programmed with external resistors. The charge current can also be programmed, typically from 100mA to 1.2A

For further information circle 271 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.

Efficient 600V IGBT



International Rectifier has introduced a family of 600V ultra-fast insulated gate bipolar transistors (IGBT), claimed as the most efficient in the industry. Known as the Gen 4 family, the devices feature a typical efficiency improvement of 20-30% over Gen 3 devices, with maximum ratings improving by up to 50%.

The new devices require less energy and have a considerably lower VCE(on) value. giving a reduced power dissipation without changes to other aspects of the device. This is achieved with essentially the same drive requirements, switching behaviour and thermal characteristics as the Gen 3 equivalent devices.

These devices are claimed to add a higher level of reliability to power conversion applications which include switch mode power supplies, uninterruptible power supplies, lighting ballasts, welding equipment and integrated motor control systems.

For further information circle 274 on the reader service coupon or contact Hartec Ltd, PO Box 264, Box Hill 3128; phone (03) 9268 9000.

DC/DC converter has 200W peak power

The new ADDC02808PB high-density DC/DC converter from Analog Devices is designed specifically for pulse applications such as solid state radar where transmit/receive (T/R) modules are used. The device operates from a 28V input bus and provides up to 200W of peak pulse power (25A pulsed output current at 8V). It is designed to cope with large changes in load current with minimum output voltage deviation, and a fast return to the nominal output voltage. Transient response is 140us for a 24A step load change.

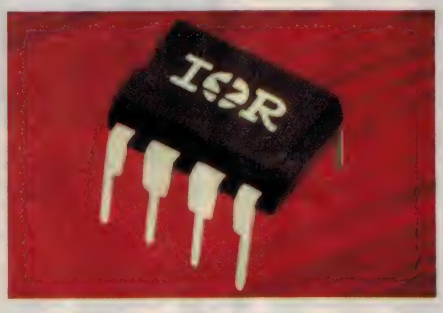
Other features include an integral EMI filter, current sharing for parallel operation, low output noise, output over-voltage protection, output short circuit current protection, thermal monitor/shutdown, input over-voltage shutdown and input transient protection.

For further information circle 279 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.

Control IC has new features

International Rectifier has expanded its IR215X family of control ICs, adding two new devices for use in half-bridge power converters in applications such as lighting ballasts, AC/DC adaptors and chargers, and consumer power supplies.

The IR2153 and IR2154 have several features that enhance performance in converter designs. For example, in fluorescent lighting applications, the new ICs include over-current shutdown or open circuit lamp protection. For AC/DC adaptor and



consumer power supply applications, features include a resonant circuit and zero voltage switching to improve efficiency and reduce power converter size.

The new ICs integrate several major functional blocks into a single chip, including a low-noise, high side gate drive circuit; a low-noise, low side gate drive circuit; a 555 type oscillator with shutdown mode; UV lockout and micropower start-up. The ICs are pin compatible with, and in many cases are a replacement for the IR2151 and IR2152.

For further information circle 278 on the reader service coupon or contact Hartec Ltd, PO Box 264, Box Hill 3128; phone (03) 9268 9000.

Digital video encoder supports Macrovision 7

Philips has announced a single-chip digital video encoder to support Macrovision 7 copy protection for both PAL and NTSC. The SAA7120 DVDenc provides the bridge between digital TV media and analog video equipment such as a TV set or VCR. Target applications include digital broadcast systems, such as DSS and DVB, as well as DVD players. According to MPC General Manager Jon Thompson, "Macrovision copy protection has been a crucial factor in persuading the entertainment industry to release the latest movies on digital video disk and satellite TV channels."

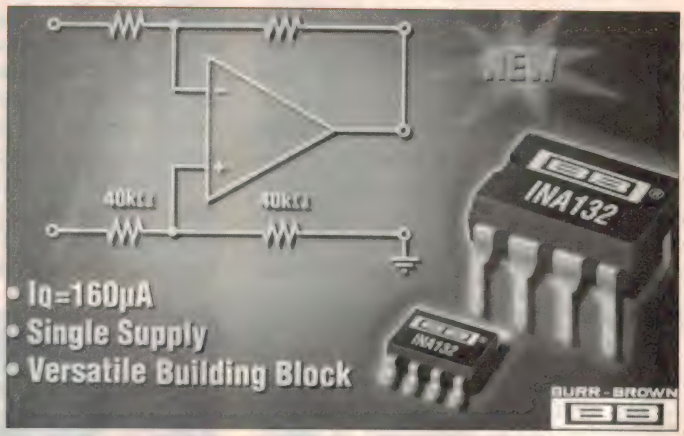
For systems which don't need Macrovision protection, such as a video CD player, a new companion part, the SAA7121, is also available. Both chips accept standard CCIR 656 format video data at a standard CCIR pixel frequency of 13.5MHz, making them compatible with most MPEG decoder chips. After encoding to PAL or NTSC standards, the video is converted to simultaneous analog composite-video baseband (CVBS) and S-Video (Y/C) signals by on-chip 10-bit D/A converters.

For further information circle 275 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 9805 4479.

Single supply difference amplifier

Burr-Brown's new INA132 is a micro power, unity-gain difference amplifier consisting of a precision op-amp with an on-chip precision resistor network. Its single supply, low voltage and micro-power operation make the device suitable as a basic building block. Functions include differential voltage measurement, precision inverter, summing amplifier, current shunt measurement, voltage controlled current source, ground loop eliminator and pseudo ground.

Its performance is guaranteed for +15V and +5V supplies and the common-mode range of the internal op-amp extends to the negative supply, making it suitable for single supply applications. Specifications include: 160uA quiescent current, 0.075% max gain error, 0.001% max nonlinearity, 90dB CMR, 2.7V to 36V single supply range, and +/- 1.35V to +18V dual supply range.



For further information circle 280 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700.

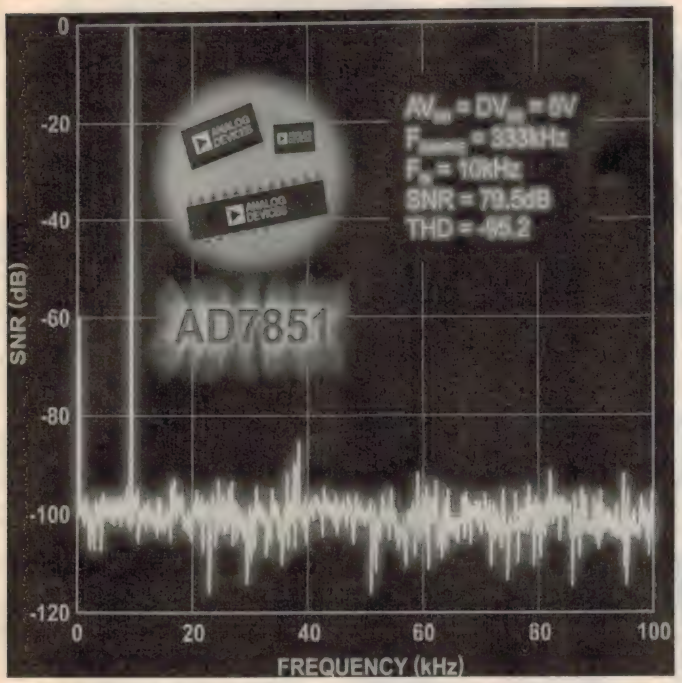
1200V/75A rated fast diode module

IXYS Corporation has announced the new MEK 75-12DA fast recovery diode module. It has two matched 1200V 75A (avg) fast diodes connected as common cathode. The two epitaxial diodes have a low reverse recovery current and a reverse recovery time of 450ns or less. They have a soft reverse voltage recovery to minimise EMI.

The diodes can be connected in parallel due to their matched on-state voltage drops. The modules have an isolation voltage rating of 3000V (RMS) and are UL recognised. Applications include rectifying the AC output from a high frequency inverter.

For further information circle 273 on the reader service coupon or contact GEC Electronics Division, Unit 1, 38 South Street, Rydalmere 2116; phone (02) 9638 1888.

14-bit ADC breaks 1MHz sampling barrier



Analog Devices has introduced what it claims as the fastest monolithic 14-bit ADC on the market. Developed for general purpose (AD7851) and high speed (AD9243) applications, the converters are specified at a 333kS/s (kilosamples per second) throughput rate. The AD7851 needs a single +5V power supply, has a power dissipation of 60mW (typical) and a power-down mode of 5uW.

With a specified sampling rate of 3MS/s, the AD9243 is said to be the first 14-bit monolithic ADC to break the 1MHz sampling rate barrier. It operates from a single +5V supply and dissipates 110mW. The ADCs are suited for applications that include general purpose motor control, car navigation systems, high speed semiconductor and telecommunication test equipment, and imaging and communications systems.

For further information circle 277 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.

300MHz processor chip for PowerPC

Motorola RISC Microprocessor Division has announced a 300MHz version of its PowerPC 603e microprocessor family. Apple Computer has also announced its newest family of mainstream computers, the Power Macintosh 6500 series, which is based on these new microprocessors, with operating speeds from 225 to 300MHz.

The 300, 275 and 250MHz microprocessors are manufactured using an advanced process technology at Motorola's MOS 13 semiconductor wafer fabrication facility. The new microprocessors have a reduced die size of 42mm^2, said to give a higher speed, lower power consumption (typically 3.5W) and lower heat dissipation. They have a 2.5V core, 3.3V I/O, a 16KB instruction cache, a 16KB data cache and 2.6 million transistors. Derivatives of the 603e will be optimised for embedded applications such as high-end printers, imaging and infrastructure for the networking and telecommunications industries.

For further information circle 276 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 9887 0711. ❖

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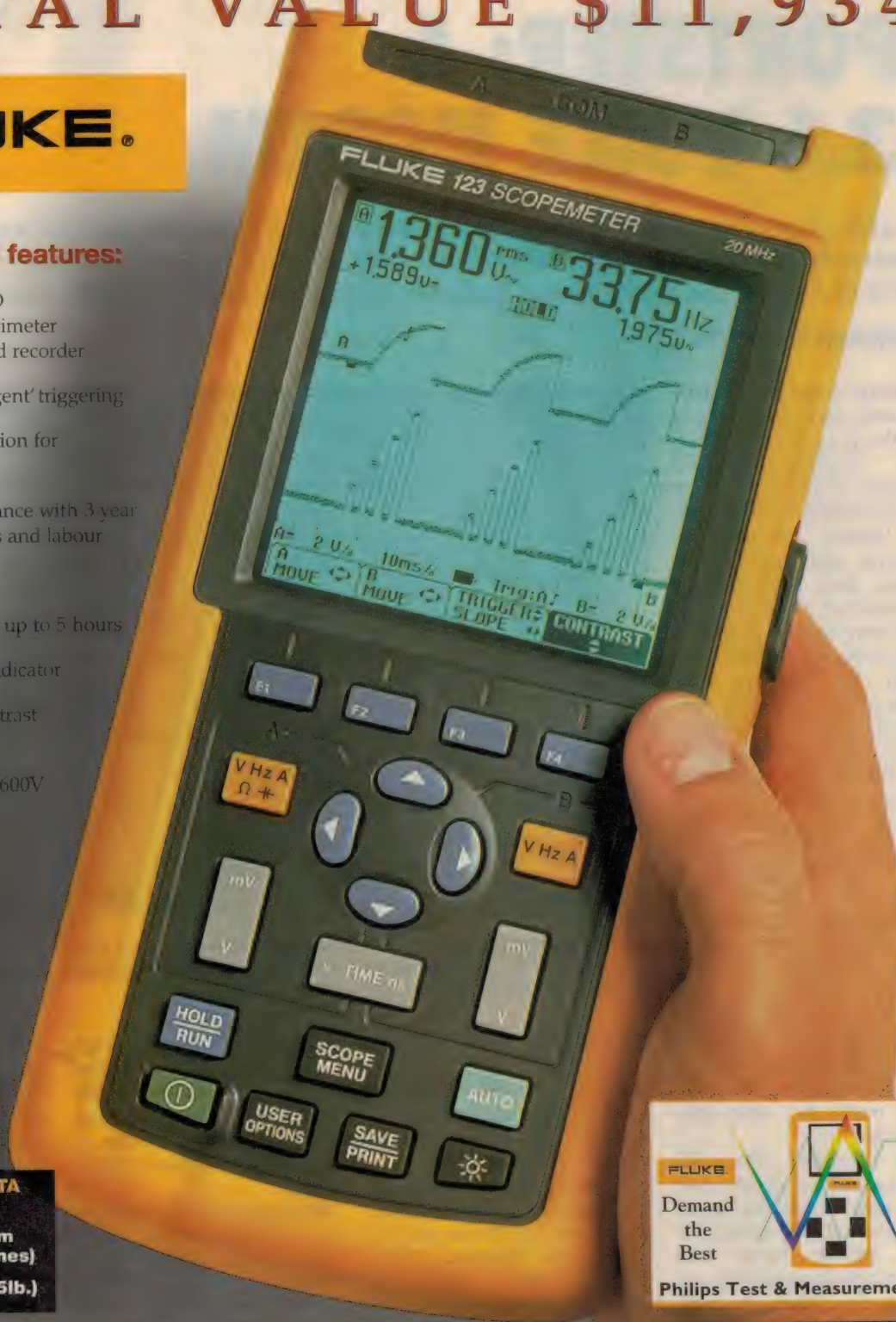

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New US Robotics modem can reach 56.6k:

SPORTSTER: A 33.6 VOICE MODEM

So, what exactly *is* a voice modem? Not being too sure ourselves, we put one through its paces to see what extra features it could provide. The Sportster 33.6 voice modem from US Robotics seems to offer a host of interesting features and can be quickly upgraded to 56.6kb/s...

by GRAHAM CATTLEY

Modems come in all shapes and sizes, and have evolved over the years from the 300-baud acoustic coupled dinosaurs of the early 70s, to today's PCMCIA 28.8k models. Recent advances in encoding and compression systems have resulted in a new breed of 33.6k modems, which may soon be overtaken by the even-newer 56.6k technology. US Robotics have foreseen this, and their new Sportster 33.6k voice modem has the capacity to be upgraded to 56k when the technology becomes available.

Voice modems, as you may have guessed, can send voice as well as data signals down the phone line (although not simultaneously). And as a result, a voice modem can offer such features as hands-free full duplex speakerphone, answering machine, and even sophisticated voicemail systems, as well as the more usual fax and data comm facilities.

The Sportster offers all this in a small, compact case that contains all the usual connectors (DB25 serial, 2 x RJ11 phone jacks and 2.1mm power connector), as well as a couple of small extras. As you can see from the photo, US Robotics have decided to go for a slightly industrial look to the Sportster, in a design that can sit flat on the desk, or stand upright with the help of a small pull-out-and-swivel foot built into the right-hand end of the case.

Easily upgradable to the new V42bis (56.6kB/s) standard, USR's Sportster 33.6k voice modem can perform a variety of voice functions, including hands-free speakerphone and answering machine, and even a sophisticated voicemail system.

Of course in order to operate as a voice modem it has to be able to hear you, and it does this with a small inbuilt electret microphone mounted in behind the front panel. On the rear, a 3.5mm audio output socket allows you to connect the Sportster up to an external (powered) speaker, while pushbutton power and volume controls are mounted on the left side.

Trying it out

The Sportster comes along with a 20V AC plugpack, a two-metre RJ11C modular phone cord and a 25-way serial modem cable. Included is an 80 page user's guide, and a floppy disk containing the 'Quicklink' software that lets you take advantage of the Sportster's voice capabilities.

We installed the Sportster in a 150MHz Pentium system, running Windows 95. After plugging everything together, we noticed that the Sportster didn't come with any Win95 drivers; in fact, it didn't come with any software drivers at all. We therefore went with the Windows default drivers, and once we'd installed the Quicklink software, everything seemed to run satisfactorily.

As we were most interested in the Sportster's voice features, the first (and simplest) test was to use the Sportster as a hands-free speakerphone. This was easy to set up in the software, and after entering the telephone number, we could hear the telephone ringing at the other end through the Sportster's internal speaker. We soon found (after a couple of confusing one-way phone calls) that this internal speaker shuts off as soon as the call is answered, and the audio is switched through to the output jack on the back of the modem.

After much searching

through the manual, it seemed that this was the only way the modem would output voice, and thus a set of external amplified speakers would be needed if you wanted to hear the other side of the conversation. (This fact was confirmed by US Robotics, who suggested using a Y-adapter cable from your sound card to an existing amplifier and speakers. They also pointed out that the internal version of the Sportster requires an external microphone as well.)

This quirk aside, the Sportster behaved itself very well, with all the functions (speakerphone, answering machine, and voice mail) performing quite well. The only slight disadvantage was that in order to use the answering machine or voice mail functions you had to leave Quicklink running the whole time, so that the modem could answer any incoming calls. Incoming fax and voice calls are auto-detected, and sent to the appropriate software.

Predictably enough, any incoming voice messages are saved on the hard drive as an audio sample, and can be played back through the Quicklink software. These samples are stored in a compressed format, and take up surprisingly little space for the quality of playback.

The Quicklink software is quite configurable, and can even be set up to dial your pager when incoming messages are recorded, or route messages to different voice mailboxes selected by the caller using DTMF tones. Class 1, Class 2, or Group 3 fax transmission is also supported at speeds up to 14.4kb/s.

Upgrade

By the time you read this, US Robotics will be able to provide a free upgrade of the Sportster 33.6k to the new 56.6k standard, although this will involve sending the modem back to US Robotics (in Australia) for the service. Unlike some other USR modems, this upgrade requires a chip replacement rather than a Flash EEPROM software patch. This is because the upgrade programs new microcode instructions into the modem's CPU, enabling it to support what US Robotics call 'x2 Technology'. With x2, data is received from your server at 56.6kb/s (V42*bis*), while upstream data is sent back at 28.8kb/s. By re-allocating the available bandwidth in this way, the higher download speed can be supported.

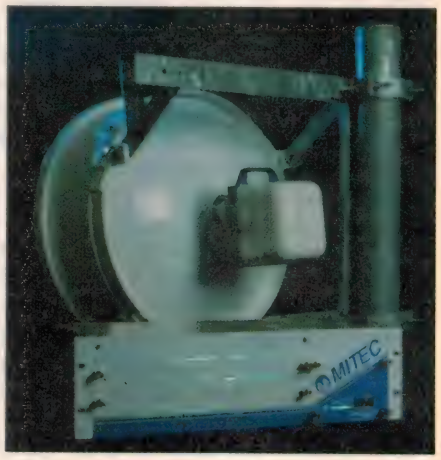
It is important to note that you may not necessarily achieve a 56.6kb/s transfer rate as soon as you upgrade; such a high data transfer rate is possible only over high quality phone lines, and only then if the server you are connected to runs at 56k as well. (Still, this is what they said when 28.8k modems first appeared on the scene...) As the upgrade is free, and US Robotics offers a five-year replacement warranty as well as a toll free after-sales support number, you don't really have very much to lose, do you? ❖

Sportster 33.6 voice modem

Good points: Simple to set up; auto detects voice/fax/data; a well priced, high performance machine.
Bad points: The case is a bit light and the modem tends to slide across the desk. Voice capabilities are only accessible through the supplied software and would require external powered speakers; no software drivers supplied.
RRP: The external Sportster retails for $249, while an internal model is available for $229.
Available: All major computer retailers, or contact US Robotics at 473-479 Victoria Street, West Melbourne 3003. Phone (03) 9482 6557.

NEW PRODUCTS

Digital microwave radio from Mitec



Queensland-based microwave technology specialist Mitec has added a new model to its range of digital microwave radios. Called the D-Series, the unit is versatile, low in cost and easy to instal in outdoor situations. It's intended for telecommunications companies and private network owners throughout Australia and overseas.

Key features of the new model include expanded operating frequency range, from 2GHz to 22GHz; the ability to operate at G.703 data rates including 2Mb/s (E1), 8.44Mb/s (E2) and 34.36Mb/s (E3). A future development will be the inclusion of a 16QAM modem.

"The D-Series extends Mitec's low and medium-capacity product range in the microwave radio market", said Project Engineer David Richardson. "Options available include a choice of frequency bands, capacity, redundancy configurations and support features."

For further information circle 247 in the reader service card or contact David Richardson or Peter Knibb at Mitec Ltd; phone (07) 3291 6333.

Calibration option for 600MHz scopes

Fluke Corporation has released the 5500A-SC600, a plug-in module that fits inside the Fluke 5500A calibrator adding the necessary functions to calibrate fully all digital and analog oscilloscopes with bandwidths up to 600MHz.

The functions include: voltage source (DC and square wave) for vertical amplitude; pulse generator for verifying dynamic response; sinewave generator flat to 600MHz, for checking bandwidth; time marks in pulsed sawtooth, square, and sinewaves from five seconds to 2ns, for timebase verification. Also included in the tests are a waveform generator for trigger function verification; TV trigger for NTSC, SECAM, PAL and PAL-M with line marker and external trigger for time marks, fast edge and voltage modes.

Other tests include input resistance, capacitance and overload testing, and a pulse generator with variable width and period to test capture functions, pulse width and period.

For further information circle 248 on the reader service coupon or contact Philips Test & Measurement, 34 Waterloo Road, North Ryde 2113; phone (02) 9888 0477.

Function gen has counter and sweep

The Q1560 digital function/sweep generator and frequency counter has a 0.02Hz to 2MHz bandwidth. It can generate sinusoidal, triangular and square waveforms, with adjustable amplitude up to 10Vp-p into a 50Ω load, and variable DC offset and symmetry. Symmetry adjustment is from 1:1 to 4:1.

Output frequency is adjusted by a front panel rotary dial with pushbutton range selection over seven ranges, and DC offset can be varied from -5V to +5V into a 50Ω load. Frequency sweep width is adjustable from 10:1 to 100:1 and sweep rate can be varied from 0.5Hz to 50Hz. The four digit LED frequency readout also has an external input, so it can function as a stand-alone 2MHz frequency counter. The instrument also has an external input to provide control over the frequency output. Applying a ramp to this input produces an externally controlled frequency sweep. It retails for $495.

For further information circle 241 on the reader service coupon or contact Altronic Distributors, 174 Roe Street, Perth 6000; phone (09) 328 2199, Internet: **www.altronics.com.au**.

Angle sensors have no moving contacts

The KM110BH/2430 and KM110BH/2470 angular displacement sensors from Philips are based on the company's magneto-resistive sensor technology and are contactless devices said to be completely free from wear and micro-linearity errors, the two most common problems with potentiometer-based angle sensors. The 2430 has a -15° to +15° measurement range about its zero-point, and produces a voltage output between 0.5V and 4.5V that is directly proportional to angular displacement. The 2470 has a -35° to +35° measurement range with an output voltage proportional to the sine of the angular displacement. Both devices are pre-trimmed to produce a zero-point output voltage of 2.5V. Typical resolution is 0.001°.

Both devices operate at temperatures between -40°C and +125°C, making them suitable for automotive applications such as engine management, safety and driver/passenger comfort systems. They are also small enough to be used in applications such as computer printers, medical equipment and instrumentation equipment as well as in general industrial applications.

For further information circle 243 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 9805 4479.

TV and video signal generators

Fluke Corporation has introduced a new series of video signal generators said to give optimum flexibility and accuracy in test signals and video standards. The Fluke 54100 video signal generator and the Fluke 54200 TV signal generator are suitable for development and production departments of television and related video equipment manufacturers, as well as service centres.

The signal generators include several new test patterns, with more than 500

test patterns available in both 4:3 and 16:9 aspect ratios. These include general patterns for calibrating geometry, synchronisation, focusing, convergence, bandwidth, interference (e.g., cross colour), amplitude response and clipping in video equipment. Other patterns are for checking additional requirements such as analog-to-digital conversion, colour reproduction, and cut-off setting. There's also test facilities for all Teletext, PDC, VPS and Closed Captioned systems. The 54200 also provides both mono and stereo test signals. Stereo test capabilities include German analog stereo, Korean stereo, NICAM stereo and BTSC/MTS stereo.

For further information circle 245 on the reader service coupon or contact Philips Test & Measurement, 34 Waterloo Road, North Ryde 2113; phone (02) 9888 0477.

Power supplies for mobile radio

Melcher is now offering modular and flexible power supply systems based on the LT series Telecom rectifier module that suit mobile base stations, microwave links, remote transmission and repeater systems, and satellite earth stations.

The system is said to provide uninterrupted operation under severe conditions with outstanding reliability. Module replacement or an expansion of the system with further modules can be done without interrupting the operation.

Included are systems with microprocessor control which allow variables to be programmed, such as application specific alarms and monitoring, or defining special operating conditions like protection against deep discharge of a battery. The systems also allow battery charging by optimum temperature compensation of the charging voltage to guarantee high battery capacity and long service life. They have a 94% conversion efficiency.

For further information circle 246 on the reader service coupon or contact Scientific Devices Australia, PO Box 163, Oakleigh M.D.C. 3166; phone (03) 9569 1366.

Intrinsically safe optical switches

Banner Engineering has released a new range of optical fibre switches, called the OFS series. They are designed for use in hazardous environments, and require no electrical energy to actuate. They are also said to be extremely effective in areas of high electrical noise, because of their immunity to electrical interference.

The switches interface directly to Banner's fibre optic photoelectric sensors, cut-to-length plastic fibre assemblies and a range of Banner sensors. The new switches are available in several family styles: operator interface switches, heavy duty limit switches, optomagnetic proximity switches and optical temperature switches. A basic optical switch element is also available, which is the basic component in most of the OFS series.

For further information contact Banner Applications Engineering, PO Box 9414, Minneapolis, MN 55440; phone 888 373 6767, Internet URL **www.baneng.com**.

Linear IC tester identifies chips

The Leaper-2 Linear IC Tester can automatically check operational amplifiers, comparators, opto-couplers, voltage regulators and many special ICs such as the 555 timer series, also transistor arrays like the ULN2000 family. Package styles include 8, 14 and 16-pin types, which are inserted into a ZIF socket on the front panel. Test results of either pass or fail are displayed on the built-in LCD.

The auto function can search for unknown ICs from its own device library, and the unit will display the device type as well as test it. It also has a self-test function which includes testing to check if an IC is inserted in the ZIF socket. The tester automatically powers down after 45 seconds of inactivity. It operates from two 9V batteries or a mains/DC adaptor and is housed in a compact handheld case.

For further information circle 242 on the reader service coupon or contact Emona Instruments, PO Box 15, Camperdown 2050; phone (02) 9519 3933. ❖

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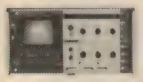

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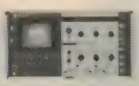

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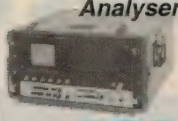

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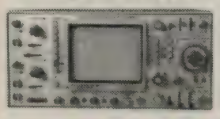

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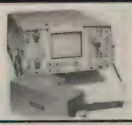

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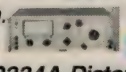

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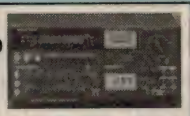

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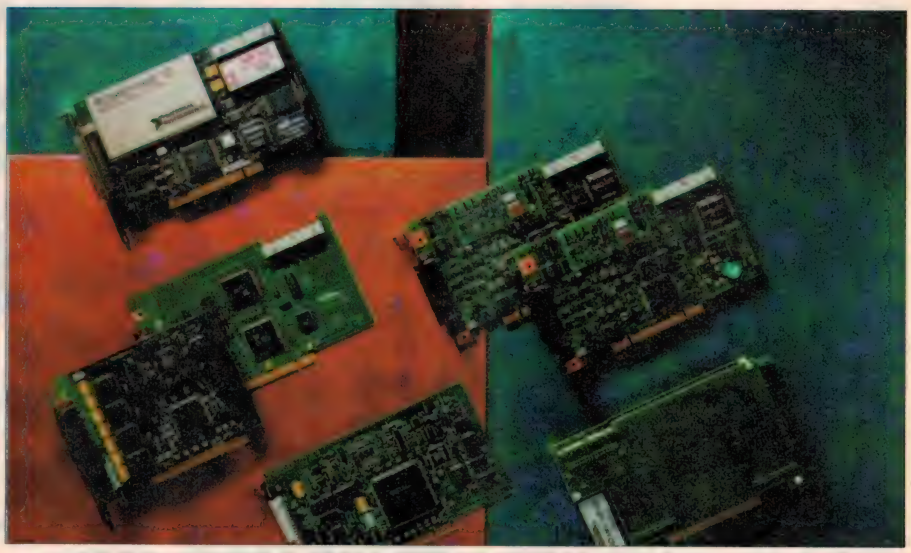
DATA ACQUISITION & CONTROL PRODUCTS

DAQ cards with DMA capability



National Instruments has announced a family of six PCI data acquisition (DAQ) boards for use with Windows NT/95/3.1. The PCI-MIO-16E-1, PCI-MIO-16E-4, PCI-MIO-16XE-10, PCI-MIO-16XE-50, PCI-1200, and PCI-DIO-96 are multifunction PCI DAQ boards with bus master DMA capability. This capability, through the company's MITE chip, improves system throughput by transferring data directly to system memory at burst rates up to 132MB/s without tying up the microprocessor.

The cards are suitable for DAQ applications that perform several tasks, such as simultaneous acquisition, analysis, and control. They are compatible with NI-DAQ driver software and LabViEW, BridgeViEW, LabWindows/CVI, ComponentWorks, Measure, and VirtualBench virtual instrumentation software. Applications include laboratory automation, industrial automation, automotive and aerospace engineering, and electronic test applications.

For further information circle 201 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 5166. Website at **http://www.natinst.com/**.

PCMCIA serial cards for lab instruments

The one and two-port PCMCIA-232 and PCMCIA-485 asynchronous serial interfaces from National Instruments provide the additional serial ports commonly needed in laboratory applications to communicate with devices such as scales and meters via a notebook computer. The cards are Windows 95 Plug and Play compatible.

Application software packages such as LabVIEW, LabWindows/CVI, ComponentWorks, and Measure, as well as development environments such as Visual C++, can access the cards using standard serial I/O functions. The PC operating system performs the configuration of the cards, so no jumpers or DIP switch settings are required.

For further information circle 203 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 5166. Website at **http://www.natinst.com/**.

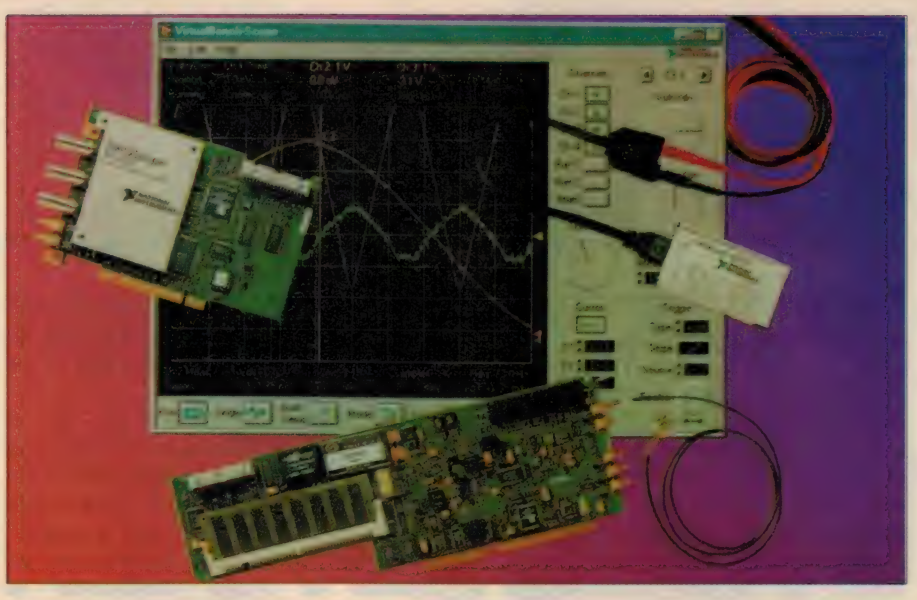
Frame grabber with overlay feature

The Image/VGA-400 PCI bus integrated frame grabber and display controller from MuTech is claimed to be the first low cost PCI bus frame grabber that allows the user to overlay text and graphics non-destructively on top of a live video display.

The card is a single slot half-size PCI board with an integrated VGA accelerator chip and display controller. It has three NTSC/PAL inputs and one S-VHS (Y/C) video input that are software selectable. Video images can be digitised and displayed in real time in a resizeable window on a VGA monitor. Text and graphics can be written into the VGA portion of the memory. Chroma key underlay of a background is also supported.

For further information circle 205 on the reader service coupon or contact The Dindima Group, PO Box 106, Vermont 3133; phone (03) 9873 4455.

PC-based virtual instruments



National Instruments has announced the first six products in its PC-based DAQ Instruments family of PCI, ISA and PCMCIA interfaces. The DAQScope, DAQMeter, and DAQArb, which are compatible with Windows NT/95/3.1 PCs are claimed to deliver features comparable to a conventional oscilloscope, digital multimeter, and a function and arbitrary waveform generator, respectively. They work with a variety of application software packages, including LabViEW and LabWindows/CVI. Instrument drivers are available for use with C/C++ and Visual Basic.

The DAQ Instruments are an extension to the company's existing DAQ hardware for building virtual instruments and can be integrated into existing systems that use National Instruments DAQ hardware and software. Programming DAQ Instruments is the same as programming all other National Instruments DAQ plug-in boards.

For further information circle 206 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 5166. Website at **http://www.natinst.com/**.

DAQ system for motors

The data acquisition and management system from Lab-Volt comprises hardware and software (LVDAM), and is available as an add-on to the Lab-Volt 0.2kW electromechanical training system (EMS system) model 8001. It comes standard with the model 8006 system.

The system can simultaneously measure several different voltages and currents, as well as speed and torque, and display the results in real time. The software can compute active, reactive and apparent power, power factor, efficiency and other parameters from the data. For example it can display a real time phasor diagram of the current and voltage in a circuit, or simulate a four-channel oscilloscope.

Although designed to work with the Lab-Volt EMS system, it can be used independently to measure motor parameters such as torque versus speed, power factor and so on. The EMS system can be replaced with software (LVSIM-EMS), with the LVDAM software running simultaneously in a tiled or cascaded window with the simulated EMS system.

For further information circle 207 on the reader service coupon or contact Lab-Volt, PO Box 289, Ingleburn 2565; phone (02) 9605 2455. ❖

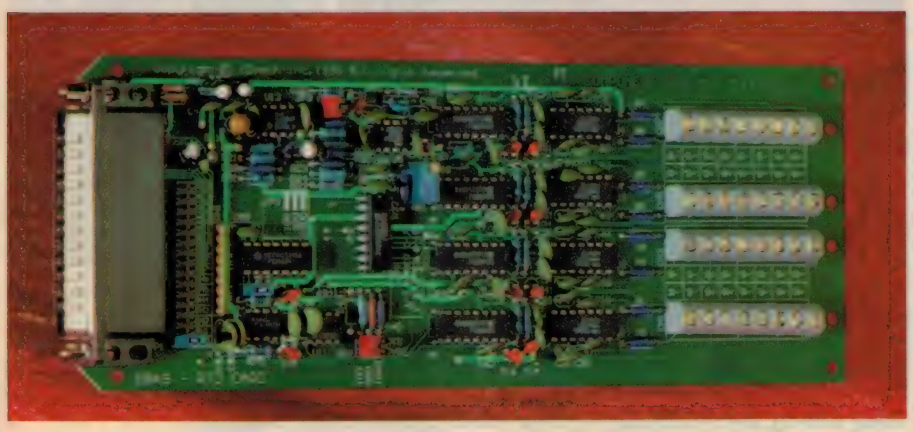
8-channel RTD card

IOtech has released the DBK9 eight-channel RTD (resistive temperature device) card. It is the company's latest addition to its DBK series of compact, signal conditioning and expansion products for PC-based data acquisition. The DBK9 supports up to eight channels of three or four wire RTDs that have resistances of 100, 500, or 1000 ohms.

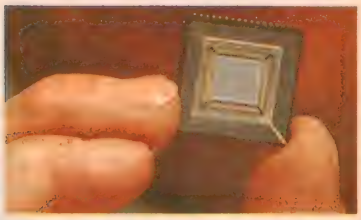
The card is compatible with IOtech's DaqBook parallel port based portable data acquisition systems for notebook and desktop PCs, DaqBoard ISAbus plug-in boards for desktop PCs, and Daq PCMCIA A/D cards for notebook PCs. All these systems provide up to 256 analog inputs.

The DBK9 is claimed to require minimal effort to configure and control because IOtech's DaqBooks, Daqboards, and Daq PCMCIA A/D cards include DaqView — a graphical set-up, acquisition and display software package that requires no programming.

For further information circle 204 on the reader service coupon or contact Scientific Devices Australia, PO Box 163, Oakleigh M.D.C. 3166; phone (03) 9569 1366.



Silicon Valley NEWSLETTER



Pentium II arrives — with possible bug

Intel has launched its much anticipated Pentium II, the new flagship processor that was designed to take desktop computing speed beyond 1GHz in the next three years. But Intel's intense public relations campaign was dealt a major setback when, a day before the PII launch, the company acknowledged a report that the chip may contain a flaw.

Intel released three versions of the Pentium II running at 233, 266, and 300MHz. "With this product, we are literally changing the shape of computing", said Paul Otellini, an Intel executive VP. "It allows us to drive costs down and allows us to scale up over the life cycle of this product."

With the Pentium II Intel is also changing the *shape* of microprocessors, as the PII comes in a rectangular card package measuring about 75 x 175mm with room for SRAM memory and other circuits. The new design is allowing competitors like AMD and Cyrix to court PC makers with chips that are nearly as powerful as the PII but fit traditional Pentium processor sockets.

Intel has already shipped more than 100,000 of the PII chips, and some 100 computer makers have announced new PCs designed around the new microprocessors.

Because the Pentium II incorporates MMX multimedia technology, industry analysts expect the machines to be sold to large number of consumers almost immediately, even though Intel maintains the initial target audience is corporate power users and network servers.

Gateway 2000, a direct marketer of personal computers said it is offering 233 and 260MHz systems starting at US$2499. "We anticipate the Pentium II processor will quickly emerge as the processor of choice for a large percentage of our customers," said Ted Waitt, Gateway chairman — adding that in the first few hours, Gateway sold over a thousand Pentium II systems worldwide, most of them consumers.

Rodney Adkins, a VP at IBM's PC Company said "The Pentium II is an integral part of both of our product lines." IBM introduced desktop PCs and workstations based on the Pentium II. Consumer models are expected to come later this year.

Intel officials tried hard not to get drawn into a discussion of the supposed flaw that surfaced just hours before the flagship chip was launched. Otellini said it was "premature to hazard a guess." The problem was first reported on an Internet site called 'IntelSecrets' in report called What Intel Doesn't Want You To Know, by Robert Collins, a long-time critic of Intel.

Collins, a former TI software engineer who designs and tests logic circuits, said he discovered the bug after a computer user alerted him to a problem with the Pentium Pro chip. After confirming the flaw in a series of tests on the Pentium Pro, Collins ran the same tests on a Pentium II which repeated the problem.

Collins said both chips sometimes make errors in floating-point operations. The chips, in order to save space and memory, sometimes handle numbers in different ways. The problem is that the processors occasionally fail to tell the software program running on it of the change, resulting in errors for some calculations involving high precision negative numbers.

Apparently Intel is taking the flaw report seriously enough to delay the introduction of some key components that will surround the Pentium II. The company said it is duplicating the tests that found the supposed flaw, and expected to have a 'good characterization' of it within days. Depending on its findings the company may issue a software patch to take care of the issue.

Novellus pays $80M to Applied Materials

Chip equipment manufacturer Novellus Systems in San Jose has agreed to pay a whopping US$80 million in damages to competitor Applied Materials, after Applied won a patent infringement lawsuit against Novellus that could have paralyzed the maker of chemical vapor deposition (CVD) systems. The settlement is the largest of its kind in the chip equipment industry and among the 10 biggest in US history.

Intel Chairman Gordon Moore (right), famous for his 'law' of development regarding semiconductor technology, recently visited astrophysicist Professor Stephen Hawking at Cambridge University in the UK. The two demonstrated the features of a new Pentium-MMX based notebook PC/wireless control and Internet communications system, which Intel engineers specially modified for easy use by the Professor — who has motor neurone disease.

Under the terms of the settlement, Novellus will be allowed to continue to sell tools incorporating the disputed technology, which the company allegedly acquired through a former Applied executive. Novellus introduced a CVD system with technology similar to Applied's just two months after the executive agreed to move to Novellus from Applied.

Novellus executives said they decided to settle the lawsuit rather than appeal it, to avoid further disruption to its business. Customers were reportedly starting to seek alternative solutions, in the event that Applied would gain the injunction it had been seeking to prevent Novellus selling any more of the products — which account for more than a quarter of its business.

The lawsuit involved equipment that produces a so-called 'TEOS' film of oxide-based insulation between the various components on the chip such as transistors and interconnect wires.

Teledesic signs $9B contract with Boeing

Four years after high tech multi-billionaires Bill Gates and Craig McCaw announced plans to finance an 'Internet in the sky' network using a fleet of hundreds of inexpensive low-orbit satellites, their Teledesic joint venture has awarded a US$9 billion contract to Boeing to build and launch the satellites.

Teledesic hopes to start offering its wireless two-way high speed communications service around 2002. The service will allow voice, high-definition video and 3D graphics images to be transmitted almost instantaneously from anywhere on the planet to anywhere else, at a cost not much above the US$20 a month service charges most Internet access providers charge.

The contract is the biggest commercial satellite deal ever. Under the terms of the contract, Boeing will mass produce hundreds of small, relatively inexpensive satellites and develop a launch system that will put dozens of them into specific orbits in a single launch. So many satellites will make up the network, a satellite will be overhead virtually everywhere on the planet at all times. Signals will be relayed from one unit to the next until it reaches a satellite covering the area of the receiving party.

Teledesic's satellite network will require 288 satellites plus a number of spares to fill in when some of the satellites malfunction. Originally, more than 800 units flying at just 200-mile altitudes were expected to be required, but Boeing engineers were able to sharply reduce the number by using the latest digital data communications technology and increasing the altitude to 450 miles. Each satellite will weight about 2800 pounds — double the original estimate; they will cost around US$20 million each, up from the initial $5M estimate.

To date, Gates and McCaw have invested about US$100 million of their own money in Teledesic. For the remainder of the $9 billion in infrastructure costs and subsequent operating expenses, they hope to line up major telecommunications conglomerates from around the world in return for the right to become a Teledesic service provider for a particular region.

But don't expect Teledesic services to be available to individual computer and telephone users any time soon. Teledesic's business plan calls for marketing the service primarily to large companies in need of secure, private, high bandwidth, high-speed global data communications.

24-hour computer TV channel starts

US television offers viewers a variety of obscure cable channels devoted to 24-hour broadcasts focusing on a single subject. There are 24-hour weather stations, traffic stations, fishing channels, shopping, and home improvement/gardening channels. Now there also is a 24-hour computer TV channel being started by Softbank and its Ziff-Davis PC publishing subsidiary.

'ZD-TV: Your Computer Channel' is a US$100 million gamble targeting beginner through advanced PC users and offering a combination of news about the latest technologies, products and corporate developments, plus how-to features that teach viewers how to operate hardware, peripherals and software products. There will be call-in talk shows, panels and forums discussing controversial issues.

"We are responding to a real need. Demand for this kind of content is incredible", said Ziff-Davis chairman Eric Hippeau. Some of the shows will be named after Ziff-Davis magazines such as *PC Week*, *Family PC* and *Computing Gaming World*.

The shows will be produced at Ziff-Davis' television studios in San Francisco. Intel, Microsoft, IBM, and Compaq are among the first 11 sponsors who have signed up as advertisers.

Compaq teams up with RCA on TV-PC

Computer maker Compaq has teamed up with RCA to develop and market a system that combines a 36" television with a built-in computer that allows the viewer to either watch regular television programming, play computer games, surf the Internet, send and receive e-mail, or perform wordprocessing and other typical computer tasks.

The Compaq-RCA 'PC Theater' will be available in consumer electronics stores in the US this fall for around US$5000. The system includes special circuitry that converts the analog interlaced TV display signal into the progressive scan format used in computers.

Compaq said the system was designed as a TV first and computer second. When it is turned on, it turns on like a TV. Only when the viewer hits a special button on the remote control does the Windows-based display start up. Users enter data and execute commands via an infrared light-based remote keyboard. ❖

HP, DEC sign up for AMD's processors

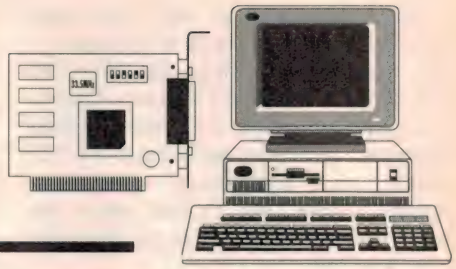
As Intel dramatically lowered prices on some of its older Pentium chips, Advanced Micro Devices signed up two major US accounts for its line of K5 and K6 processors.

Digital Equipment became the first large US computer maker to announce plans to launch a line of PCs built around AMD's new K6 chip. Then heavyweight Hewlett-Packard said it would bring out a line of sub-US$1000 machines using the older K5 chip. The four Vectra 500 PC models hit stores in May, and are designed to fit AMD's K6 processor at a later stage. The HP move surprised many, since the Palo Alto company has become such a big supporter of the Wintel dynamo with its co-development of the Intel AI/64 next-generation 64-bit processor, and the recently announced endorsement of Windows NT. Trying not to appear as leaning too far in the direction of the K6, HP officials emphasized they currently don't have plans to use the K6 because "it's too expensive".

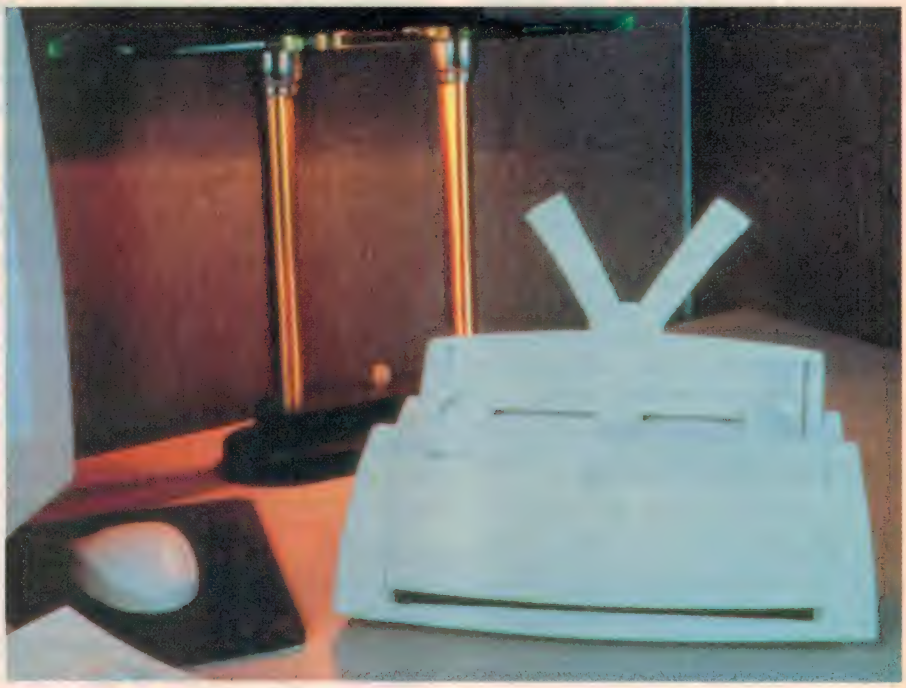
A third major PC maker, Taiwan's Acer, is also said to be seriously considering a K6-based line of computers.

Acceptance of the AMD chip by major systems houses spells good news for consumers, who are likely to see prices of high-end PCs coming down much faster than during the past 10 years when Intel had sole control over the high-end PC processor market. "The second half of the year is going to be very interesting for the microprocessing market", said Mona Eriba, an analyst at Gruntal & Co.

Computer News and New Products



Low cost scanner



Hewlett-Packard has released the HP ScanJet 5s scanner, with an estimated street price of $351 (including sales tax), the cheapest scanner HP has ever offered. The new sheet fed scanner is a 24-bit colour and 8-bit greyscale device with an optical resolution of 300dpi and 600 dpi enhanced resolution. It is compatible with Microsoft Windows 3.1, 95 and NT 4.0.

The scanner comes with PaperPort software and can scan documents up to 21.5 x 76.2cm. It works with any standard Windows printer, attaches through the parallel port, comes with a parallel pass-through interface and links with many popular applications. The optional automatic document feeder can hold up to 10 pages.

For further information phone the HP Customer Information Centre on 131347 or visit HP's scanner Web site at **http://www.hp.com/go/scanjet**.

Computer touchpad

VersaPad is a new computer touchpad from Interlink Electronics said to give precise cursor control with a fingertip or a stylus. It has a one-touch pan and scroll capability, a toolbar that can be personalised, and on-the-fly signature and graphics capture. A variety of 'touch sensitive' user features are also available.

The dedicated pan and scroll bars for screen control can be operated in three ways: by applying pressure to the arrows at the ends of the bar, with movement proportional to the applied pressure; by placing a finger (or stylus) on a specific portion of the bar to pan or scroll to that position; or by sliding a fingertip along the bar to pan or scroll in that direction.

The five key toolbar can be customised, and comes preprogrammed with cut, copy, paste, save and graphics capture functions. It can also be accessed on-screen as a pop-up toolbar.

For further information circle 162 on the reader service coupon or contact BJE Enterprises, 124 Rowe Street, Eastwood 2122; phone (02) 9858 5611 or visit **http://www.interlinkelec.com** on the Web.

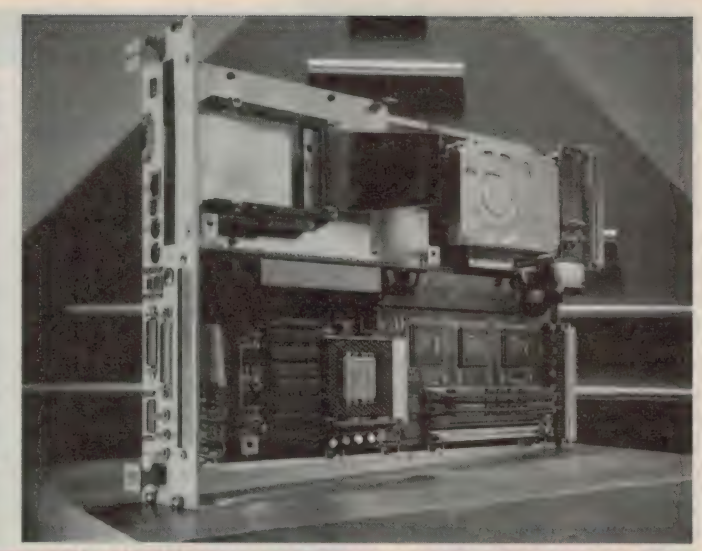
20-slot rack mount PC chassis

Intelligent Systems Australia has announced the IAC-820B, a 20-slot rack mount PC chassis. The industrial chassis is designed for use in hostile work environments in engineering, scientific, telecommunications, data acquisition and process control applications.

The chassis has 20 full length slots and five disk drive bays (2 x 5.25", 3 x 3.5") and its heavy steel construction with hold-down clamps enables the system to withstand heavy vibration and shock. It also contains two cooling fans, and the hinged and lockable front door keeps dust out. The chassis can be configured with various full and half-size CPU cards and also provides standard DIN connectors on both front and rear panels.

For further information circle 166 on the reader service coupon or contact Intelligent Systems Australia, PO Box 118, Berwick 3806; phone (03) 9796 2290. Internet site at **http://www.intelsys.com.au**.

200MHz Pentium embedded VXI controller



National Instruments has announced a 200MHz version of its VXIpc-850 embedded VXI controllers. The VXIpc-850/200 exceeds the performance of the company's 166MHz Pentium-based VXIpc-850/166. Purchasers of 166 and 133MHz embedded controllers can upgrade by replacing a modular daughterboard containing the new 200MHz processor.

The company is also reducing the prices on its Pentium-based embedded controllers by up to 25%. All controllers are VXI plug&play compliant and are compatible with PC-compatible software tools, the company's LabVIEW and LabWindows/CVI application software, and NI-VXI/V/SA bus interface software.

For further information circle 164 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 5166. Website at **http://www.natinst.com/**.

Demo board for Virtual Dolby Surround

Medianix Semiconductor, Inc. has announced the availability of a new reference design and demonstration board for systems that deliver realistic three-dimensional (3D) sound from two ordinary stereo speakers. The EVB25006-3 board enables digital consumer audio developers to easily implement 3D surround sound audio for such applications as video games, PCs, and television and stereo systems using only two speakers.

Based on the MED25006 Virtual Dolby Surround processor IC introduced by Medianix in January 1997, the board will be used as a reference design for original equipment manufacturers (OEMs) and by software developers to test and design new applications. With the addition of amplifier, speakers and audio source, the board provides a complete 3D surround sound audio system. It features plug-and play-operation and does not require a PC interface or any DSP programming for implementation.

The board was designed to demonstrate the capability of the MED25006, which is an all-digital implementation of Virtual Dolby Surround using proprietary 24-bit DSP technology to digitally process two-channel audio into two-channel 3D surround sound. The IC includes digital Dolby ProLogic decoding and Dolby's virtualizing algorithms on-chip. It is well suited for use throughout a product family (at a variety of price points) because it is capable of operating in full-digital Dolby Pro-Logic mode, Dolby 3 Stereo mode, and Virtual Dolby Surround mode.

For further information circle 170 on the reader service card or contact Medianix Semiconductor Inc, 100 View Street, Suite 101, Mountain View, CA 94041; phone (415) 960 7081 or on the Web at **www.medianix.com**.

PC-based virtual reality

Superscape is a PC-based software package that supports virtual reality using a colour monitor as the output device. Virtual reality is a medium in which a synthetic three dimensional environment can be examined from any perspective, in real time.

The package includes an integrated design and development program which provides editors and facilities to build virtual worlds and virtual reality applications. Over 20 ready-made virtual worlds and more than 200 virtual clip art objects are included. The package is aimed at education and training applications.

For further information circle 160 on the reader service coupon or contact Training and Technical Supplies, PO Box 289, Ingleburn 2565; phone (02) 605 2455.

32M Flash memory disk drive card

The PC FlashDisk card is an ISA bus card with up to 32M bytes of Flash RAM. The card provides a bootable hard drive with read-write capability, and runs under a wide range of operating systems. It has a typical write cycle lifetime of one million writes and average seek time of less than 0.1ms.

For industrial applications, DiskOnChip is a bootable Flash disk (4MB, optional 8MB), that fits in a socket on a single board computer. It contains ROM-DOS 6.22 and loads as a BIOS extension taking 32KB bytes of RAM.

The flash disk boots as drive C:, enabling operation without a floppy or a hard drive. It is read and write capable, with the Flash memory management handled automatically by a Flash file system, which makes the device appear as a conventional drive.

For further information circle 167 on the reader service coupon or contact Click Electronics, 29 Bachell Avenue, Lidcombe 2141; phone (02) 9649 4155, email comgiant@ca.com.au.

PC-based programmer

The LCP family of 80C51 programmers supports the entire line of Philips 80C51 microcontroller derivatives, and is said to be a low cost way of programming microcontrollers. It is designed for use with a standard PC. The programmers are suitable for development purposes or short production runs.

There are two models: one for standard 40-pin DIP and 44-pin LCC devices, the other for 24 and 28-pin DIP and 68-pin LCC devices.

Each kit has the necessary hardware and software to program Philips microcontrollers using an IBM compatible PC/XT/AT and includes a programmer board with ZIF sockets, 9-pin D serial connector and 9V power connector. Also included is software, a user manual, cables, and a universal 100 to 260 volt AC power supply with IEC socket.

For further information circle 168 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 9805 4479.

Tiny IR data transceiver modules

TEMIC Semiconductors has announced what are claimed as the world's smallest IrDA-compatible data transceiver solutions, offering data transmission rates up to 4Mb/s.

The new TEMIC 'BabyFace' devices are less than half the size of the industry's previous smallest transceivers with the same capabilities, measuring just 9.7 x 4.7mm with a height of 4mm. Unlike other miniaturized IrDA-compatible transceivers, they require no additional metal shielding to create a complete, surface-mount solution. Internal automatic gain control circuitry ensures maximum sensitivity, even with a high level of optical interference.

Combining 2.7V to 5.5V operation with this small package size, the new BabyFace transceivers will be ideal for use in mobile phones, pagers, and personal digital assistants. Thus enabled, users can easily exchange data among and between these portable systems and IR-enabled printers, fax machines, or desktop computers. An integrated IR transceiver likewise allows cell phones and pagers to be programmed at the point of sale with a cordless data connection.

Both new BabyFace devices integrate the optical components and mixed-signal control chip necessary for an optimized IrDA implementation. The TFDU4100 offers data transmission rates up to 115.2kb/s at distances up to 3 metres, while the TFDU6100 offers transmission rates up to 4Mb/s at up to 1m. To help prolong battery life, standby power consumption for both transceivers is remarkably low: 500nA for the TFDU4100 and 100uA for the TFDU6100.

For further information circle 169 on the reader service card or contact distributor Braemac, 1/59-61 Burrows Road, Alexandria 2015; phone (02) 9550 6600.

Development system for 80XC51

The PDS51 is a board level, 12MHz in-circuit emulator for the Philips 8XC51 family of microcontrollers. It gives access to the internal registers and allows full execution control without using any chip resources. This means the microcontroller in the target system can be replaced with the PDS51, enabling the target system to be run, monitored and debugged without changes to code or hardware.

The system consists of two interconnected modules. The motherboard contains the systems common to any derivative emulation such as the control microcontroller, logic, communication interface and power supply. The daughterboard contains the bondout microcontroller which determines the target devices able to be emulated. Free upgrade IDE software is available from the Philips Internet site at **http://www.he.net/~pds**.

For further information circle 163 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 9805 4479. ❖

Scanner is Windows NT compatible

Hewlett-Packard has announced a price reduction of its HP ScanJet 4C scanner ($1518 estimate, including sales tax), and that the scanner is now Microsoft Windows NT compatible. The new version is called the HP ScanJet 4Cse and comprises a HP ScanJet 4c scanner bundled with HP DeskScan II image capture software, Caere OmniPage limited edition OCR software, PaperPort, Corel Photo-Paint, HP ScanJet Copy Utility and the CorelWeb.Graphics suite, a Web authoring application.

The 4C scanner features 30-bit colour capabilities, 2400dpi enhanced resolution and 600dpi optical resolution. Accessories include a 50-page automatic document feeder (around $850), a transparency adaptor for 35mm slides and other transparency media ($1150).

For further information phone the HP Customer Information Centre on 131347 or visit HP's scanner Web site at **http://www.hp.com/go/scanjet**.

WEBWATCH

presented by GRAHAM CATTLEY

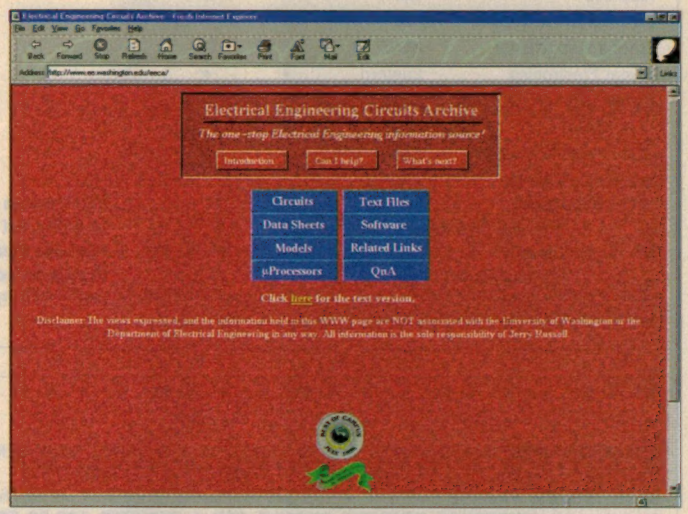
The Electrical Engineers Circuits Archive

http://www.ee.washington.edu/eeca/

The EECA is a site devoted to expanding the availability of circuit designs to engineering students, and engineering professionals. Maintained by Jerry Russell at the University of Washington, this site is a growing collection of electronics resources that is intended to cover almost every aspect of electronic design.

At the moment, the site contains a wealth of information on semiconductors and schematics for hundreds of different circuits, most of which are in ASCII form. These are text files that contain the schematics drawn using standard ASCII characters and are surprisingly easy to read. As well as circuits, the site contains heaps of text files on a huge range of subjects, including a database of over 40,000 transistors!

Due to the vast amount of data needed for such a project, he relies on submissions from anyone who is interested in the archive. Material can be submitted for inclusion into the EECA via email, and he welcomes all contributions.

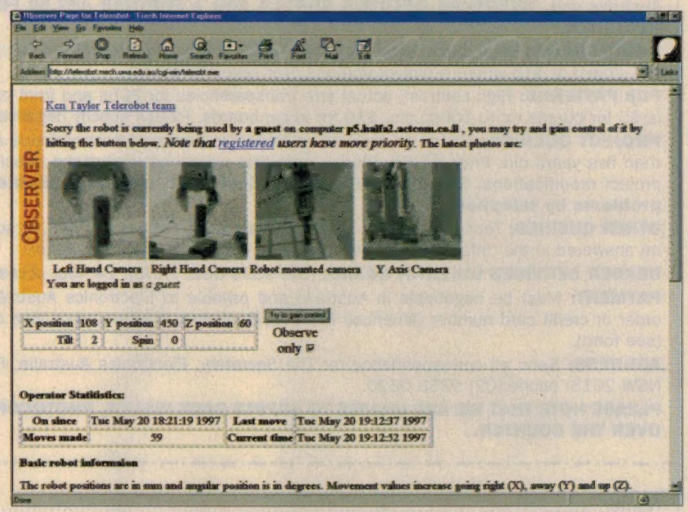


Australia's Telerobot on the Web

http://telerobot.mech.uwa.edu.au/

Somewhere deep inside the Robotics and Automation Lab at the University of Western Australia, a lone robotic arm is constantly rearranging a pile of coloured wooden blocks. This wouldn't sound too exciting, were it not for the fact that it can be controlled by you! You can send commands to the robot with your web browser, and see the results of your actions from four cameras positioned around the work area.

The remote user receives still video images of the robot's workspace and can move the robot's gripper through all dimentions. The site isn't just limited to the person operating the robot; users waiting to control the robot can watch the arm following the instructions from the controlling user (You can even send quick messages to the controlling user while you watch!). As well, the site contains links to other robotic resources, and also to another web-connected robot situated in Pittsburgh.



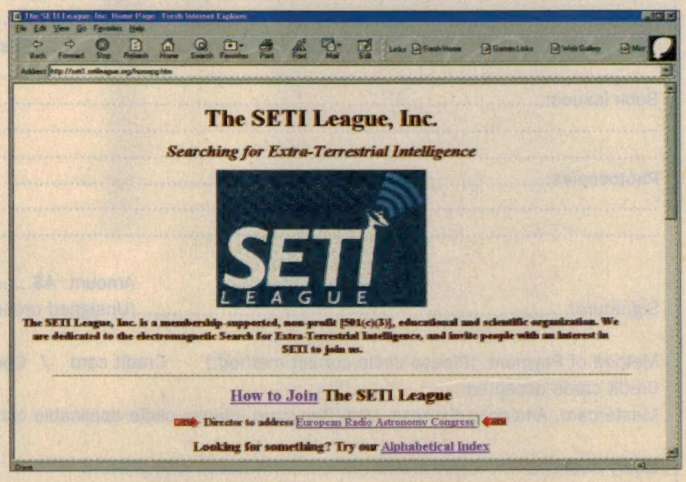
SETI League

http://seti1.setileague.org/homepg.htm

SETI stands for Search for Extra-Terrestrial Intelligence. In 1993, US Congress ceased funding to NASA's SETI project and so Richard Factor, an amateur radio enthusiast, decided to take up the challenge of organising radio hams around the world to take over the project. Known as the SETI League, this group monitor the skies in what is called 'Project Argus', a network of listening posts situated around the world. The goal of the 500 SETI League members is to get 5000 amateur stations around the world organised into a systematic search for extra terrestrial transmissions.

This web site contains a lot of detailed information on setting up your own receiving station, which can cost as little as $1000 all up. Special software is also available that helps to detect the narrow band signals that would be part of an ET transmission, and a low-cost receiver kit should soon be available to keep the cost of starting up a station to a minimum.

So if you want to help, log on to this web site and join the SETI League — who knows? You could be the one, listening at the right place at the right time... ❖



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KEY TO CODING

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		G	**Reference books**

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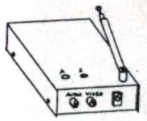

MINI TV STATION

Make your own mini TV station with this metal cased, commercial transmitter with telescopic antenna. Dimensions 123 x 70 x 20mm, 12V operation. Includes power switch, indicator LED, RCA audio and video connectors, twin RCA-RCA lead. Our 32mm AUDIO PREAMPLIFIER kit (**$8**) comes (with an electret microphone), and a CCD camera will complete the station. Transmitter **$30** or **$20** when purchased with a CCD camera. REGULATED 10.4V-500mA PLUGPACK to power the whole system: **$10**

AUDIO - VIDEO MONITOR

Compact high resolution 5" screen B/W audio and video monitor. Has two way audio, built in microphone, audio amplifier, speaker and pushbutton "talk" switch. Needs a pre-amplifier and microphone for remote audio monitoring (our 32mm audio preamplifier is ideal). Has two camera inputs to allow manual or auto switching (adjustable speed) between each camera. Needs 12V DC 1A (our switched mode supply is ideal), size 160 x 190 x 150mm, has audio and video outputs for connecting to a VCR etc. Monitor and 6-way mini input connector only: **$125**

SWITCH MODE POWER SUPPLY

Compact (50 x 360 x 380mm), in a perforated metal case, 240V AC in, 12V DC/2A and 5VDC/5A out: **$17**

CCD CAMERA

Tiny (32x32x27mm) CCD camera, 0.1 lux, IR responsive (works in total dark with IR illumination), connects to any standard video input (eg VCR) or via a modulator to aerial input: **$120**,

KITS FOR CCD CAMERA SECURITY

New INTERFACE KIT FOR TIME LAPSE RECORDING: now has relay contact outputs! Can be directly connected to a VCR or via a learning remote control: **$25** for PCB and all on-board components, used PIR to suit: **$12**.

- **32mm 10 LED IR ILLUMINATOR** new IR (880nm) LEDs have an output about equal to our old 42 LED IR illuminator: **$18.**
- **32mm AUDIO PREAMPLIFIER** An **$8** kit that produces a 'line level' signal from an electret microphone, connect the output to our
- **UHF VIDEO TRANSMITTER** (**$30**) or **$20** when bought with the camera. for a complete Audio-Video link.

32mm AUDIO AMPLIFIER: An LM380 based **$9** audio power amplifier which can directly drive a speaker — needs the 32mm preamplifier. *WHAT IS 32mm?* All boards are 32mm, so you can house these kits in a plastic 32mm joiner: cheap plumbing part.

12V VCR

Coming soon, ideal for CCD camera security system. See our Web site for more details.

STEPPER MOTOR DRIVER KITS

Kit includes a large used 1.8º. (200 step/rev) motor and used SAA1042A IC. Can be driven by external or an on-board clock; has a variable frequency clock generator. External switches (not provided) or logic levels from a computer etc determine CW or CCW rotation, half or full step operation, operation enable/disable, clock speed. PCB and all on-board components: **$18** for kit with 1 motor, **$28** for kit with 2 motors.

DIAMOND TESTER KIT

Test if they're real! PCB, on-board components and meter movement: Available late this month. **$15**

VISIT OUR WEB SITE

On our very active WEB SITE you will find: ■ kit of the month ■ our catalog ■ new products ■ info on our advertised items ■ ordering info. http://www.ozemail.com.au/~oatley

DC MOTOR

New, Australian made (Preslite) 12V DC motor used to power golf buggies. Low speed, very high torque. 75mm dia, 150mm long, 7mm dia 30mm long shaft, weight 2kg. Has three 5mm tapped holes for mounting. No load current 4A, loaded current 10A. Great for experimenting with battery powered vehicles, wind generators etc. Limited supply at a small fraction of their real value: **$36**

Speed controller kit to suit: **$20**

PC POCKET SAMPLER KIT

Ref EA Aug '96. Data logger/sampler, connects to PC parallel port, samples over a 0-2V or 0-20V range at intervals of one/hour to one/100uS. Monitor battery charging, make a 5kHz scope etc! Kit includes on-board components, PCB, plastic box and software (3.5" disk): (K90) **$30**

WOOFER STOPPER Mk II

Works on dogs and most animals, ref SC Feb 96. PCB and all on-board components, transformer, electret mic & horn piezo tweeter: (K77) **$43**, extra tweeters (drives 4): **$7** ea Approved 12V plugpack (PP6) **$14**

UHF REMOTE TRIGGER Single channel Rx and Tx: (K77T) **$40**

MASTHEAD AMPLIFIER KIT

Our famous MAR-6 based masthead amplifier. 2-section PCB (so power supply section can be indoors) and components kit (K03) **$15.** Suitable plugpack (PP2): **$6** Weatherproof box: (HB4) **$2.50**. Box for power supply: (HB1) **$2.50** Rabbit-ears antenna (RF2) **$7** (MAR-6 available separately)

USED ICs

Guaranteed, previously socketed ICs, never soldered to. Data not supplied.

- 146818P — real time clock: **$4**,
- R65C21P2 — 6821 PIA: **$2**
- P8031 — 8-bit CPU: **$2**
- 6803 — 8-bit CPU: **$4**
- HD680G — 8-bit CPU: **$4**
- R6545 — CRT controller: **$2**
- HD6845 — CRT controller: **$2**
- HD6821 — interface adaptor: **$1**
- AY3-1015 — 8-bit UART: **$4**

LIMITED STOCK SPECIALS

- BRIDGE RECTIFIERS: 35A - 400V in diecast aluminium: **5** for **$15**
- TRIACS: Mitsubishi BCR8PM-8L 8A/400V in insulated case similar to TO220: **10** for **$14**
- SCHOTTKY DIODES: 7.5A/45V Motorola MBR745 TO220: **10** for **$18**
- DC FAN: small DC motor with 3 blade push on plastic fan: **$3**
- PLASTIC HANDLES: Robust recessed, for stage speakers and equipment, 10 mounting holes, dimensions 130 x 170 x 50mm: **$5**
- PLASTIC CORNERS: Robust, dimensions 80 x 80 x 80mm: **$1.30**

USED PIR MOVEMENT DETECTOR

Commercial quality 10-15m range, used but tested and guaranteed, have open collector transistor (BD139) output and a tamper switch, 12V operation, circuit provided: **$10**

5mW/650nm VISIBLE LASER POINTER KIT

YES, NEW 650nm kit. Very bright! Complete laser pointer that works from 3–4V DC. Includes 650nm/5mW laser diode, new handheld case 125x39x25mm, adjustable collimator lens, PCB battery holder: (K35) **$39**

DISCO LASER LIGHT SHOW PACK

The above 5mW/650nm kit plus our AUTOMATIC LASER LIGHT SHOW: **$99**

12V - 2.5W SOLAR PANEL KIT

US amorphous glass solar panels with backing glass: (S12) **$22** ea **4** for **$70**

WIRELESS IR EXTENDER

Converts the output of any IR remote control to UHF. Self-contained transmitter attaches to IR remote. Kit includes two PCBs, all components, 2 plastic boxes, Velcro strap: (K89) **$39.** (9V battery not included). Plugpack for Rx (PP10): **$11**

SUPER BRIGHT BLUE LEDS

BY FAR THE BRIGHTEST BLUE EVER OFFERED, super bright at 400mCd: **$1.50** ea or **10 for $10**

5mm LEDS AT SUPER PRICES

- 1Cd red: **10 for $4**
- 300mCd green: **$1.10** ea. or **10 for $7** (*make white light by mixing the output of red green and blue*)
- 3Cd red: **$1.10** ea. or **10 for $7**
- 3Cd yellow (small torch!) also available in 3mm: **10 for $9**
- Super bright flashing LEDs: **$1.50** ea. or **10 for $10**

BATTERY BONUS Twin AAA battery holder and two AAA batteries for 60c with any LED purchase: flash a high intensity LED for a month! Limit of 3 per customer

COMPUTER CONTROLLED STEPPER MOTOR DRIVER KIT

PCB and components kit plus information and IBM software: (K21) **$35**. Kit plus 2 stepper motors (small M17 or large M35) (K21M): **$48**

PHOTO TRANSISTORS

Enclosed in clear 5mm housing (like a 5mm LED), 30V/3us/<100nA dark current: **$1.30** or **10 for $9**

CAR ALARM KIT WITH THE LOT

This kit can armed/disarmed by a hidden switch, or by a UHF REMOTE CONTROL which also has provision for operating a CENTRAL LOCKING KIT. The CAR ALARM kit includes a PCB, all on-board components and ultrasonic transducers. It features ultrasonic movement detection, provision for bonnet-boot protection (pin switches not supplied), vibration detector and a flashing high intensity LED. Four LEDs make for easy diagnostics and setting up: **$35**

CENTRAL LOCKING This four door central locking kit is a commercial product that includes 2 master and 2 slave actuators, wiring loom, control unit, necessary hardware and instructions: **$60**

The **UHF REMOTE CONTROL KIT** has a switched relay output for operating an alarm etc, an indicator output for driving a buzzer etc, and logic level outputs for operating the CENTRAL LOCKING KIT. Comes with a ready made transmitter with two pushbuttons (lock, relay on - unlock, relay off), and a receiver PCB and all on-board components. 5 LEDs make for easy tuning and diagnostics: **$35**

SIREN KIT, includes speaker **$12**

NICAD CHARGER & DISCHARGER

Professional, fully assembled and tested fast NICAD battery charger and discharger PCB assembly. Switch mode circuit, surfaced mounted on a double-sided PCB with gold-plated through holes and pads. Has 6 ICs, 3 indicator LEDs, 3 power MOSFETs, a toroidal inductor and many other components: over 100 in total. Nominal unregulated input 13.7V DC, 900mA charge current. Appears to use voltage slope detection for charge terminating, also has a timer (4060) to terminate the charge. We supply a thermistor for temperature sensing. Probably for fast-charging 7.2V AA nicads. Three trimpots allow some adjustment. Basic information provided, plugpack not included. *Incredible pricing:* **$9** ea or **3 for $21**

MOVING MESSAGE DISPLAY PCB

Used, complete PCB assembly with bright dot matrix red LED displays and driver. Circuitry includes twenty 74HC164 ICs. Has 20 displays each with 35 LEDs (700 LEDs!). Displays are in a single line to form a continuous display. Display size is 280 x 18mm, PCB 330 x 75mm. Needs external 5V supply. Includes a simple program on disk and instructions to make the display scroll number "1" through all displays, via a computer parallel port. Limited quantity: **$40**

MOTOR AND PUMP

New, compact plastic pump with a 240V AC 50Hz 0.8A 91W 2650 RPM induction motor attached. Probably a washing machine part. Very quiet operation, made in Japan, overall dimensions 160 x 90 x 90mm, weight 1.2kg, inlet 25mm diameter, outlet 20mm diameter. Other end of motor has 20mm long 4mm dia shaft. Motor can be rewound for lower AC voltage and or reduced power operation without disassembling the unit. We calculated 5.5 turns per volt: **$19**

MAINS MOTOR

New induction motor, probably for clothes drier. Dimensions 110 dia x 100mm long, 10mm dia 40mm long drive shaft, weight 3.3kg, has mounting bracket, made in Japan. Power around 1/4HP, brief information supplied: **$19**

SOLAR REGULATOR

Ref: EA Nov/Dec 94 (intelligent battery charger). Designed to efficiently charge 12-24V batteries from solar panels, but can also be used with simple car battery chargers (like Arlec 4A chargers) to prevent overcharging. Regulates by sensing battery voltage. Has voltage reference IC. Suitable for currents up to 16A, and can be easily modified for higher currents (by paralleling MOSFETs and Shottky diodes). Extremely high efficiency due to the very efficient MOSFET switch and Shottky isolation diode. Has negligible standby current consumption. The PCB is now smaller and we offer a 7.5A or 15A kit. The 7.5A kit has one Shottky diode and the 15A kit has two: **$26**/**$29** (K09)

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One week delivery...and, of course, one year guarantee.

SPECIFICATIONS	ZHL-42	ZHL-4240	ZHL-42-W	ZHL-424OW
Frequency, GHz	07 to 4.2	0.7 to 4.2	0.01 to 4.2	0.01 to 4.2
Gain, dB min.	30	40	30	40
Gain Flatness, dB	±1.0	±1.5	±1.5	±1.5
Power Out @ 1 dB CP, dBm min	+29	+29	+29*	+29*
VSWR in/Out, max.	2.5:1	2.5:1	2.5:1	2.5:1
Noise Figure, dB typ	10.0	4.0	8.0**	8.0**
Power Supply, V/ma	+15/690	+15/700	+15/750	+15/850
Third Order Intercept, dBm min.	38	38	38	38
Second Order Intercept, dBm min.	48	48	48	48
Size, in.	.7 x 3¼ x 2⅛ h.	.7 x 3¼ x 2⅛ h.	.7 x 3¼ x 2⅛ h.	.7 x 3¼ x 2⅛ h.

*+ 28 dBm, 10 MHz to 700 MHz, 3500 MHz to 4200 MHz
**Below 100 MHz increases to 15 dB at 10 MHz

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